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Insects

FOURTH ANNUAL REPORT

OF THE

ENTOMOLOGIST

OF THE

State Experiment Station

OF THE

University of Minnesota,

To The Governor,

FOR THE YEAR 1898.

BY OTTO LUGGER,
Professor of Entomology,
UNIVERSITY OF MINNESOTA.

ST. PAUL:
McGill-Warner Co.
1899.

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LETTER OF TRANSMITTAL.

State Experiment Station,
University of Minnesota.

January 1, 1899.

To His Excellency, D. M. Clough, Governor of Minnesota:

Sir—In accordance with the law, I have the honor to present herewith my fourth annual report as Entomologist of the Experiment Station of the University of Minnesota for the year ending December 31, 1898.

Very respectfully,
Your obedient servant,
Otto Lugger.

FINANCIAL REPORT.

1897.			No. of Vouchers.	Amount.
Aug.	1.	To bill of Whitall, Tatum & Co	4	$48.38
	1.	“ “ W. H. Gruenhagen	5	2.00
	1.	“ expenses of E. B. Forbes and H. Lugger	6-7	3.00
Sept.	1.	“ salary and labor for August, 1897	8-9	130.00
Oct.	1.	“ salary and labor for September, 1897	10-11	130.00
	1.	“ bill of G. E. Stechert	12	17.70
	1.	“ “ Cambridge Bot. Supply Co	13	5.60
Nov.	1.	“ salary and labor for October, 1897	14-16	110.00
	1.	“ expenses of E. B. Forbes	17	12.25
Oct.	25.	“ “ “ “	1	6.80
Nov.	1.	“ bill of Houghton, Mifflin & Co	2	50.00
	3.	“ drawing materials	3	1.85
	10.	“ bill of J. A. Schlener & Co	4	5.98
	13.	“ “ for typewriter supplies	5	.95
	15.	“ “ of Ch. Scribner's Sons	6	5.80
	27.	“ “ “ McMillan Co	7	11.83
	30.	“ “ “ St. Anthony Park Ice Co	8	5.00
Dec.	1.	“ salary and labor for November, 1897	9-11	115.00
	1.	“ bill of W. H. Gruenhagen	12	3.00
	5.	“ expenses of E. B. Forbes during Sept., Oct., Nov	13	5.45
	5.	“ express	14	3.75
	10.	“ Zimmerman Bros	15	14.90
	14.	“ Art Engraving Co	16	25.00
	14.	“ expenses	....	1.15
	27.	“ salary and labor for December, 1897	17-19	115.00
	17.	“ stamps	20	12.00
	29.	“ express, custom	21-23	8.65
1898.				
Feb.	1.	“ Bausch & Lomb Optical Co	1	24.47
	1.	“ salary and labor	2-4	115.00
	1.	“ copying report	5	11.55
	1.	“ illustrations	6	24.00
	1.	“ expenses of E. B. Forbes	7	3.85
	1.	“ bill of Fuchs & Lang Mfg. Co	8	3.77
	1.	“ “ L. M. Hart	9	25.20
	1.	“ “ G. E. Stechert	10	13.71
	1.	“ bill for electrotypes from Washington	11	8.90
	1.	“ express	12	6.60
	1.	“ expenses	....	1.10

1898.			No. of Vouchers.	Amount.
Mar.	1.	To salary and labor for February, 1898	1-3	105.00
	1.	“ typewriting	4	13.50
	1.	“ expenses of E. B. Forbes	5	7.00
	1.	“ “ “ H. Lugger	6	2.05
	1.	“ bill of L. M. Hart	7	26.25
	1.	“ Art Engraving Co	8	25.00
	1.	“ bill of E. F. Baker	9	8.25
	1.	“ “ John Schmitt	10	25.20
	1.	“ “ G. E. Stechert	11	5.90
	1.	“ “ W. H. Gruenhagen	12	1.32
	1.	“ “ Goodyear Rubber Co	13	1.00
	1.	“ “ Deming Co	14	7.50
	1.	“ express and freight	15	3.82
	1.	“ expenses	......	1.25
April	1.	“ salary and labor for March, 1898	1-3	140.00
Mar.	13.	“ trip to Lake City and Red Wing	4	7.00
April	4.	“ bill of Zimmerman Bros	5	2.73
	4.	“ “ Noyes Bros. & Cutler	6	2 41
Mar.	23.	“ “ Minneapolis Paper Co	7	5.00
	7.	“ meat, etc	8	.72
April	1.	“ expenses	....	1.35
	15.	“ bill of McGill-Warner Co., for Annual Report		1,550.00
May	1.	“ salary and labor for April	1-3 and 6	155.40
	1.	“ bill of C. F. Baker	4	12.00
	1.	“ A. A. Heller	5	1.80
	1.	“ paper, express and stamps	7-9	16.10
	1.	“ expenses	....	4.30
	1.	“ trip to Grand Forks	10	9.25
	1.	“ Am. Entom. Soc	11	4.00
	1.	“ Zimmerman Bros	12	2.42
June	1.	“ salary and labor for May	1-3	145.00
	1.	“ bill of Harper	4	4.00
	1.	“ “ Bausch & Lomb	5	5.50
	1.	“ bill for printing	6	16.50
	1.	“ bill of J. H. Herbst	7	9.65
	1.	“ “ Acad. Nat. Sc	8	6.00
	1.	“ trips made by H. Lugger	9	5.60
	1.	“ W. Boss	10	4.75
	1.	“ trips to Red Wing and Osceola	11	4.56
	1.	“ “ N. Dakota and Red River valley acct. locusts	12	20.25
	1.	“ bill of Zimmerman Bros	13	3.10
	1.	“ “ Noyes Bros. & Cutler	14	2.00
	1.	“ stamps	15	15.00
	1.	“ W. F. Lindig	16	2 00

1898.			No. of Vouchers.	Amount.
June	1.	To express, etc	17	4.25
July	1.	“ salary and labor for June	1-4	345.00
	1.	“ bill of G. E. Stechert	5	14.00
	1.	“ “ J. A. Schlener & Co	6	12.66
	1.	“ “ Zimmerman Bros	7	13.93
	1.	“ “ W. H. Gruenhagen	8	6.00
	1.	“ “ Art Engraving Co	9	18.00
	1.	“ “ C. T. Leonard	10	17.50
	1.	“ “ H. Lugger, trip to Mankato	11	7.65
	1.	“ stamps	12	15.00
	1.	“ bill of J. H. Herbst	13	3.37
	1.	“ “ S. E. Olson Co	14	3.25
	1.	“ express	15	2.05
	1.	“ bill of Bausch & Lomb	16	.59
	1.	“ trip to Perham	17	9.50
	1.	“ bill of McMillan Co	18	4.31
	1.	“ “ Electr. Eng. Co	19	5.40
	1.	“ trip to Taylor's Falls and expenses	....	6.75
July	31.	“ salary and labor for July	1-4	345.00
	31.	“ bill of C. C. Hunter	5	6.45
	31.	“ “ John Schmitt	6	27.30
	31.	“ “ Tribune Printing Co	7	6.00
	31.	“ “ Zimmerman Bros	8	12.73
	31.	“ “ Webb Publ. Co	9	2.75
	31.	“ “ Charles Scribner's Sons	10	5.80
	30.	“ trip to Willmar	11	9.00
	30.	“ “ Faribault	12	7.50
	30.	“ bill of Art Engr. Co	13	17.50
	30.	“ “ Olson	14	1.86
	30.	“ “ Gruenhagen Bros	15	1.82
	30.	“ express	16	1.35
	30.	“ stamps	17	15.00
	30.	“ trip to Duluth	18	8.50
	30.	“ bill of Zimmerman Bros	19	55.80
	30.	“ “ for ice	20	2.00
	30.	“ “ of J. H. Herbst	21	7.79
	30.	“ “ for ice for June	22	2.00
	30.	“ expenses	....	4.95
				$4,430.83

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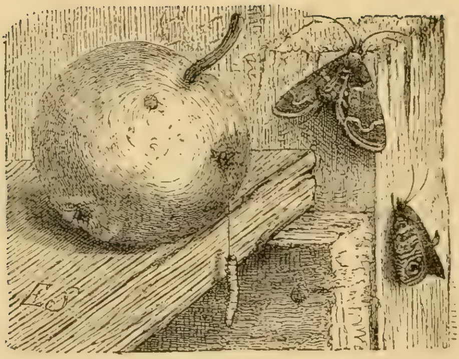


Codling-moth and Flour-moth.

INTRODUCTION.

The fourth annual report of the Entomologist of the State Experiment Station of the University of Minnesota, respectfully submitted to His Excellency, Governor D. M. Clough, contains an account of all Butterflies and Moths found in Minnesota which are destructive in their earlier states to our fruit-bearing trees, shrubs and canes, and which frequently cause considerable losses to our fruit growers. As orchards are now established in many parts of the state, and as the insects destructive to the plants are not as well known to our horticulturists as in the older settled regions of the United States, where horticulture as a business has been carried on for many years, a report describing and illustrating these insects, and giving the best remedies to prevent their injurious influence, is much needed. It is, however, impossible to describe all the numerous and destructive insects found in our orchards in one single report, and for this reason only the very important order of Lepidoptera is described in the following pages.

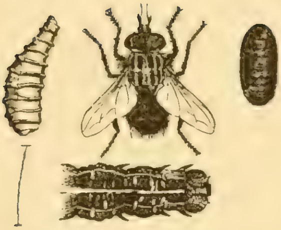
It would have been perhaps best to have the insects described in this report arranged according to their food-plants, but to make it also useful to students of our public schools, etc., the insects are arranged according to the classification of Lepidoptera usually adopted, and the different families have been described in a few words.

There remains for the Entomologist the pleasant duty of expressing his sincere thanks to all persons that have aided him in many ways in his work. Especial thanks are due to the different newspapers, who with unfailing courtesy published all articles written for the instruction of the farmers in regions infested by injurious insects. The Chicago, St. Paul, Minneapolis & Omaha, the Great Western, the St. Paul & Duluth, the Northern Pacific, the Minneapolis & St. Louis, the Great Northern and the Minneapolis, St. Paul & Sault Ste. Marie Railroad Companies also deserve thanks for their liberality in furnishing free transportation over their roads whenever such was asked.

The descriptions of many of the insects given are taken from a number of sources, but mainly from the excellent works of Saunders, Smith, Comstock, Fernald, Beutenmueller, Forbes and of the Annual Reports of the Division of Entomology. Most of the illustrations are old, and many were kindly loaned by Dr. L. O. Howard, Chief of the Entomological Division of the Department of Agriculture. The Art Engraving Co., of St. Paul, prepared some of the illustrations for the printer, and deserves credit for its good work.

OTTO LUGGER.

XV.



The Beneficial Tachina-fly.

BUTTERFLIES AND MOTHS

INJURIOUS TO OUR FRUIT-PRODUCING PLANTS.

Butterflies and moths are better known to the casual observer than other insects. The former, which are active only during the day, and which fly in the brightest sunshine, are frequently so beautifully colored as to well deserve the name "winged flowers." The term "*Lepidoptera*," which means scale-wings, is well chosen, as the insects belonging to the *Order of Lepidoptera* have both sides of their wings, as well as their bodies, more or less densely clothed with scales. These *scales* differ greatly in form and size, even in the same insect, and yet more so in the different groups, so that a certain family may even show forms peculiar to it alone. Some of these scales are not simply organs that serve as a protection to the wings proper, but they possess other functions as well, hence we find sometimes very highly developed scales on the wings of the male only, usually confined to very limited areas, or even concealed in folds. Scales are simply modified hairs, which, instead of growing long and slender, remain short and grow very wide. Every graduation in form, from hair to scale, can be found. If we capture with our fingers a butterfly or moth, and let the insect escape again, we find adhering to our fingers dust of various colors. If we look at this dust with a magnifying glass, we perceive at once that this glistening material is not simply dust, but that it is composed of scales rubbed off the wings and body of the captured insect. Numerous beautiful and highly-colored scales of different shapes are thus seen. When we study the wings from which these scales are removed we see that such scales are arranged as regularly as the scales on a fish, or the shingles on a roof, and we can also detect how the beautiful markings on the wings are produced. A glance through a microscope will show us that the colored spots and lines on the wings are made by grouping together colored scales in the same way as we frequently see upon the roofs of barns the year of their erection in colored shingles which strongly contrast with the neighboring ones of different colors. Part of a wing, with some of the scales removed, as well as some of the scales, is shown in Fig. 1. The scales covering these insects doubtless strengthen and ornament the wings, and protect as an armor the body and legs. If we study the colors and markings of a lepidopterous insect, we can well imagine that both serve almost opposite purposes, both protect the insect, it is true, but in a different manner. In most cases the colors and markings are such that if the insect is at rest, they blend with the colors of the surrounding objects. Persons that are in the habit of seeking for insects of this order, notwithstanding that they soon have their eyes thoroughly well trained, are frequently misled

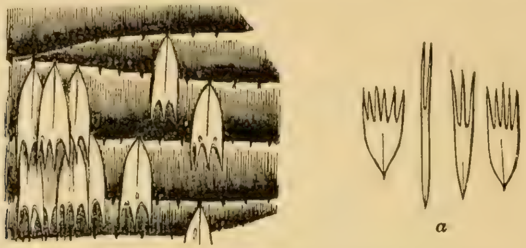


Fig. 1.—Part of wing, showing arrangement of scales: *a*, individual scales. Greatly enlarged. After Packard.

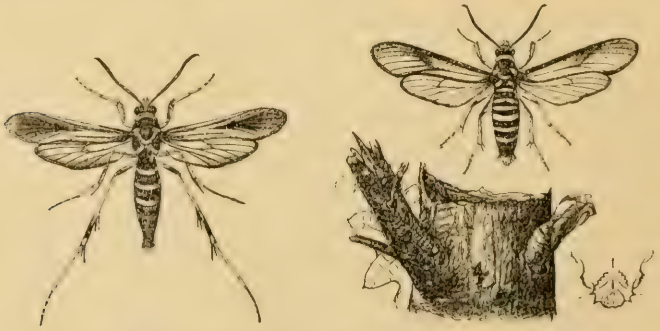


Fig. 3.—Clear-wing moths resembling wasps. Original.

and do not perceive the insect right "under their eyes" until it moves. This is a case of "*protective colors.*" Fig. 2, plate I, shows some geometric moths thus protected. Other colors are "*warning colors.*" In this case the butterfly or moth either posesses the form and color of a stinging insect, Fig. 3, or it has colors found upon insects not eaten by birds. Moths having such warning colors do not hide, but expose themselves very openly upon some object that contrasts strongly with their colors and thus they become very plainly visible.

The Milkweed butterfly (*Danais archippus* Fab.) Fig. 4, plate I., belongs to a genus of butterflies which are not eaten by birds, very likely because they are poisonous or otherwise offensive, hence these showy insects, being thus well protected, are very common wherever their food plants occur. The Disippus Butterfly (*Limenitis disippus* Gtd.) belongs to a genus of butterflies very palatable to birds, yet notwithstanding this it escapes, being no doubt mistaken for the unpalatable Milkweed Butterfly, which it so closely resembles. Compare Fig. 5, plate I. with Fig. 4 of the same plate.

The *wings* themselves consist of two thin, translucent or transparent membranes, which are kept apart by hollow, horny tubes, the *ribs, costæ* or *nerves*; the form of the wings is usually triangular, posessing therefore three margins, the *anterior*, *interior*, and *exterior* or *posterior* margin (Fig. 6). The space where the fore-wings join the body is called the *basis*. The shape of the wings depends upon the ribs or veins, which have received by scientists special names, as well as the spaces or cells they enclose. The classification of lepidoptera is mainly based upon the arrangement of such veins and cells.

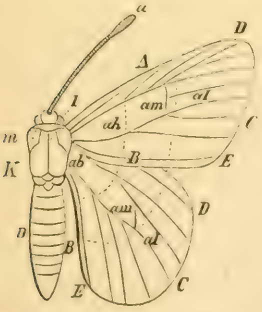


Fig. 6.—Wings: *A*, anterior margin; *B*, interior margin; C, exterior or posterior margin.

The *mouth-parts* of moths and butterflies are only adapted for sucking nectar from flowers, and not for chewing their food. The main part is a long sucking-tube (Fig. 7, *h*), composed of two greatly elongated *maxillæ* fastened together side by side; as each maxilla is furnished with a groove the two maxillæ fastened together form a perfect tube by means of which the liquid food is conveyed to the mouth and stomach. Usually this tongue is quite smooth, but in some cases its tip is furnished with spines, which enable the insect to rupture the skin of ripe fruit to obtain its juice. As many moths do not eat they lack a tongue, or possess only a rudimentary one. This important organ, when not in use, is curled up like the mainspring of a watch, and is hidden and protected by the labial palpi (Fig. 7, *l*), which for this purpose project forward. Moths and butterflies, in extracting nectar from flowers, become very useful in pollenizing them; some plants, indeed, have to depend altogether upon these insects for their continued existence.

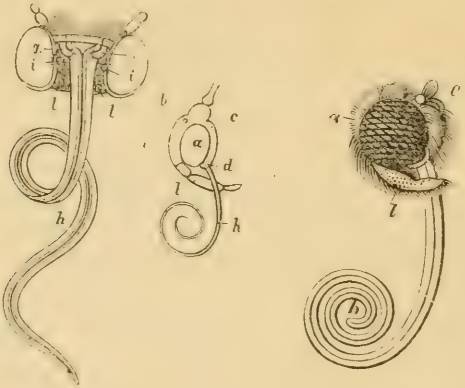


Fig. 7.—Head: *a*. compound eye; *h*, tongue; *l*, labial palpi. Enlarged.

The compound and unmovable eyes (Fig. 7, *a*) of lepidoptera, are large and composed of many small facets, each of which is a perfect eye. This arrangement enables the insect to look in many directions at the same time. These compound eyes are either globular or oval; they are naked or covered with short hairs, but in some cases we find long and lash-like hairs.

The *antennæ or feelers* vary greatly in their shape, and form a very important organ for classification. They are composed of many joints, from 30 to 100; they vary not alone in shape and length in the different families, but even the sexes of one and the same moth may possess entirely different antennæ, those of the male being frequently toothed, etc., while those of the female are simple. The antennæ are sense organs, hence highly organized and important for the insects, which become disabled if they are removed. The illustration (Fig. 8) shows a number of differently formed antennæ.

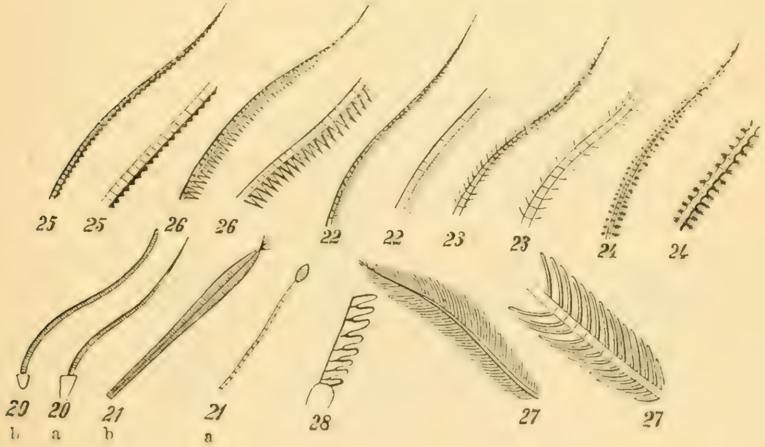


Fig. 8.—Antennæ or feelers. Enlarged.

The *legs* are not always perfect, but in some families of lepidoptera they are more or less aborted. In Fig. 9 we have both perfect and imperfect examples. Cases occur where the legs are entirely absent, at least in the female sex, as shown in the Bag-worm described later.

The *metamorphosis* of this order of insects is complete, and we can hardly imagine a greater difference in form than that between the *egg*, *caterpillar*, *pupa* and *imago* of the same insect. (See Figs. 16 and 19).

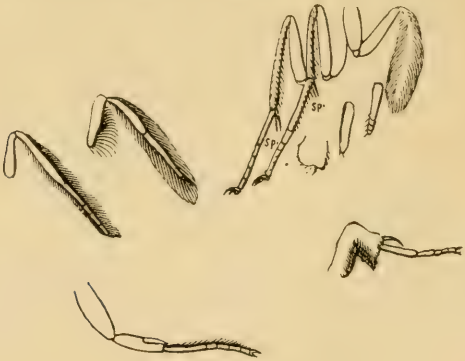


Fig. 9.—Legs. Enlarged.

The *eggs*, which are always, if possible, deposited upon or near the food needed by the caterpillars or larvæ, are of many different forms. A few are shown in Fig. 10. They vary also in color, though most of them are greenish, or greenish-white. Some eggs are quite smooth, others are beautifully ornamented with numerous ribs or other projections; some are deposited singly, others in more or less regular masses, sometimes carefully covered with glue or scales. Some eggs hatch in a very short time after being deposited, while others remain for half a year exposed to all

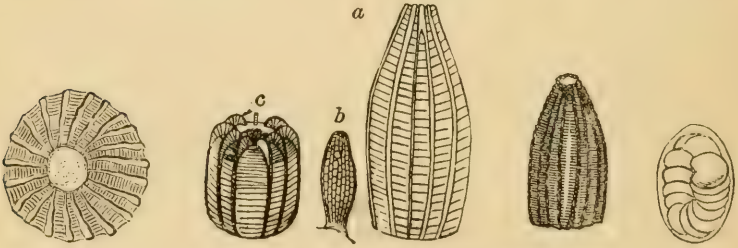


Fig. 10.—Different kinds of eggs.

kinds of weather before they show any changes previous to hatching. These changes consist in a darkening of the eggs; in some cases, where the shell is thin, we can observe the gradual formation of the enclosed embryo, as shown in the illustration. As soon as ready the young caterpillar eats its way through the shell, and sometimes the very first meal it enjoys in the open air is the very egg-shell that protected it before.

Caterpillars, which are the second state in the existence of all butterflies and moths, vary in every conceivable manner, as may be seen by studying the illustrations in the text. Usually, however, they are cylindrical beings, composed of head and twelve *rings* or *segments*. The *head* (Fig. 11), is the most specialized part of the larva; it is usually horny, since the muscles moving the powerful chewing organs are fastened to it *internally*. The illustration shows that it is separated by a central line (*a*) into two equal parts. The triangular *clypeus*, the small *ocelli* (*b*), the *antennæ* (*c*), the *upper lip* or *labium* with the horny *jaws* or *mandibulæ* (*d*), are also shown. The *under lip* or *labium* is not seen, but the four-jointed *maxillary-palpi* (*e*), and the two-jointed *labial palpi* (*f*) are shown. At the end of the labium is located a very important organ, the *spinning-tube*, through which the substance flows that is used by the caterpillars to make the protecting silken cocoons. The caterpillars differ very greatly from the adult insect by possessing a biting and not a sucking mouth, hence they can become very destructive to agriculture, horticulture and forestry by consuming plants which we intend to use ourselves. The first three segments of a caterpillar behind the head are the *thoracic segments*, and to them are fastened three pairs of *jointed feet*, which later transform into those found in the winged insect; the other segments

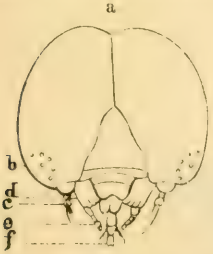


Fig. 11.—Head of caterpillar; *b*, ocelli; *c*, antennæ; *d*, mandibles; *e*, maxillary palpi; *f*, labial palpi. Enlarged.

are called *abdominal segments*, and these form later the abdomen of the adult or imago. The abdominal segments carry the *false legs* or *prolegs*, which disappear in the butterflies or moths. Such prolegs are not jointed but are equipped with rings of hooks that enable the caterpillar to grasp securely the object on which it moves; the last segment is usually distinguished by a pair of prolegs formed somewhat differently from the others. Most caterpillars possess, including the true legs, sixteen legs, but the loopers or measuring worms have only ten, and those living in bags but six. All caterpillars, or worms looking like caterpillars, which possess more than sixteen legs, are not the larvæ of lepidoptera, but are those of saw-flies, insects belonging to the order of Hymenoptera. Such worms are called "*false caterpillars*." Upon the first thoracic segment of a true caterpillar we find quite often a horny plate; this is the *cervical shield*, used in throwing off the head-plate when the insect is moulting; another plate, the *anal-shield*, occurs frequently upon the last segment. The *breathing-pores* or *stigmata* occur as small openings upon the sides of the body. Not all caterpillars are cylindrical, however, and forms occur that resemble in external shape sow-bugs or slugs. Some caterpillars are densely covered with hairs, sometimes arranged in tufts or brushes; others are only clothed with a few hairs, or with spines, while still others are naked.

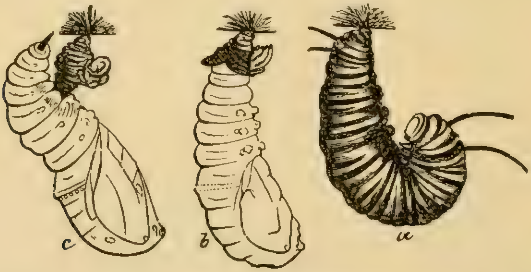


Fig. 12.—Moultingof the caterpillar of *Danais archippus*; *a*, larva suspended; *b*, pupa still partly in larval skin; *c*, pupa in the act of leaving the skin entirely. After Riley.

Some can cause more or less inflamation by means of urticating or stinging hairs or spines, but none are really poisonous. Many caterpillars are brilliantly colored, or are ornamented with bright, longitudinal or vertical stripes, or with spots of various shapes and colors. Most are terrestrial, none really aquatic, and but few consume animal food. They grow by throwing off their old skins from three to five times, a process that is called *moulting*. This process is a very interesting one, as may be seen by studying the illustration in Fig. 12, commencing at *a*.

As soon as the larva, worm or caterpillar has reached its full size, it transforms to a *pupa* or *chrysalis*, which is unable to move or to eat, lacking in this form both legs and mouth. It appears to be dormant, but in reality is quite active, as all the organs simply foreshadowed in larva or pupa have to be changed into the very different organs found in the imago. In other words the biting mouth of the larva has to be changed into the sucking mouth of the moth; the small and simple eyes or ocelli have to be transformed into compound eyes; the small legs are made longer, and the external organs and wings are produced during this apparent rest. The internal organs are also very greatly altered; the large stomach of the caterpillar is reduced to almost nothing, and in its place appear the reproductive organs, as eggs, etc. There are many different kinds of pupæ, some of which are shown in Fig. 13, and those familiar with the study of lepidoptera can tell at a glance to what families

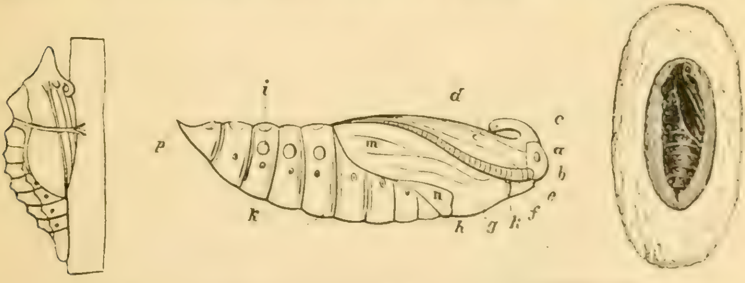


Fig. 13.—Pupa of butterfly, hawk-moth and owlet-moth.

they belong. Some pupæ are found suspended, others are enclosed in a silken or earthen cocoon, while still others are found in a smooth cell in the earth.

After remaining in this condition for a shorter or longer time, the *imago* or *perfect insect* leaves the pupal skin through an opening in the back. At first the wings are very minute, being folded up in numerous wrinkles; but they expand very rapidly, and as soon as the tubes or veins in the wings are filled with air, and the skin covered with scales is fully expanded and dried, the insect can fly about, a thing of beauty, and a very different being from a crawling caterpillar.

More than six thousand species of lepidoptera have been described from North America, north of Mexico, which represent more than sixty families. In order to give a synopsis of the lepidoptera, it would be necessary to enter into rather difficult technical details, and a bulletin like this is not the proper place to do so, hence those that wish to study this order more in detail are referred to such valuable works as those published by Comstock, Packard, Smith and others.

In a rather crude way we divide the lepidoptera into two groups, into *Butterflies* and *Moths*, the *Rhopalocera* and *Heterocera*. These terms are derived from the form of the antennæ of these insects; *Rhopalocera* are those in which the antennæ terminate in a more or less distinct knob or club at the tip, and in which at least the front pair of wings are elevated and vertical when at rest, so that the upper surfaces touch, as may be seen in the illustration of Grapta (page 68). The *Heterocera* possess feelers of many different kinds, none of which are distinctly clubbed; their wings, when at rest, are horizontal, folded on the back and close to the sides, oblique, roof-like or spread out flat, but never habitually vertical. Usually butterflies are active during the day, while moths are night-flyers; this is a rule which has, however, many exceptions, as some moths fly during the day.

The *Butterflies* separate readily into groups based on the character of the feet and the situation of the antennæ.

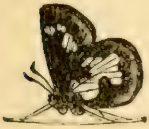


Fig. 15.—Skipper.

The so-called "*true butterflies*" are distinguised by having the antennæ set close together on the top of the head, this being rather narrow; the antennal club is abrupt at the tip, and not drawn into hook or recurved. In the *skippers*, the head is broad, the eyes are comparatively small, the antennæ are widely separated, set close to the eyes, and terminate in a pointed tip, which is often recurved or hooked. Fig. 16 shows a true butterfly, and Fig. 15 a skipper or Hesperid. A large series of the true butterflies is distinguished by having the anterior pair of feet more or less aborted or imperfect, as is shown in Fig 9. To these "*brush-footed*" butterflies belong two families, the *Nymphalidæ*, which contain medium or large sized species, and the *Lycænidæ*, small species, usually blue or coppery in color, and frequently called "blues" or "hair-streaks." Members of the family *Papilionidæ* are large and showy butterflies, whose anterior feet are perfectly developed in both sexes. To this family belong the large "swallow-tails" and insects like the cabbage-butterflies.

The Moth or *Heterocera* are much more difficult to classify, and the reader interested in such matters is referred to the text-books. But usually we divide the Heterocera into Hawk-moths (*Sphingidæ*); Clear-winged moths (*Sesidæ*); Wood-nymph moths (*Agaristidæ*); Woolly-bears (*Arctiidæ*); Vaporer or Tussock moths (*Lymantriidæ*); Slug-caterpillars (*Limacodidæ*); Bag-worms (*Psychidæ*); Prominents (*Notodontidæ*); Royal moths (*Ceratocampidæ*); Silk-spinners (*Bombycidæ*); Borers (*Cossidæ*); Owlet-moths (*Noctuidæ*); Span-worms (*Geometridæ*). Butterflies and moths are frequently called Macro-lepidoptera or large lepidoptera, while all the others are called Micro-lepidoptera or small lepidopteria. These latter are also divided into numerous families, such as the (*Pyraustidæ*); Pyralids (*Pyralidæ*); (*Phycitidæ*); Bee-moths (*Galleriidæ*); Crambids (*Crambidæ*); Feather-moths (*Pterophoridæ*); Leaf-rollers or

Bell-moths (*Tortricidæ*); (*Chonchilidæ*); (*Grapholithidæ*); and Tineids (*Tineidæ*), to which belong numerous families of such insects as leaf-miners, cloth and fur-moths, grain-moths, etc.

As this bulletin is mainly written for tbe use of the horticulturist, it is impossible to make it at the same time a text-book, hence only those insects are described in detail, that cause injuries to our fruit and fruit-producing plants. But for the sake of the general student a number of illustrations have been added that will at least show other lepidopterous insects not described in detail, yet necessary to give an idea of the classification of this order of insects. Only well known or destructive species have been selected for this purpose.

BUTTERFLIES.

(*Rhopalocera*).

FAMILY NYMPHALIDÆ OR FOUR-FOOTED BUTTERFLIES.

These butterflies are also called "brush-footed;" they differ from all others in our fauna in having the fore-legs very greatly reduced in size in *both sexes*. The legs are so much dwarfed that they can not even be used for walking, but are folded against the breast like a tippet.

THE MILKWEED BUTTERFLY OR MONARCH.

(*Danais archippus* Fab.).

This well known large butterfly, with reddish-brown wings marked with black veins and white spots, is very abundant in late summer and fall. It sometimes gathers in large armies about our wind-breaks, just previous to migrating south, where it spends the winter. The caterpillars, which grow to about an inch and a half in length, are greenish marked with black bars, and are furnished with rather long, black, hair-like tentacles; they feed upon the common milkweeds. As this insect is very common, and can easily be raised in captivity, those that wish to see for themselves the metamorphoses of insects can do so without much trouble. All that is necessary is to furnish the caterpillar with a fresh supply of food whenever needed. Before long the caterpillar will fasten itself by

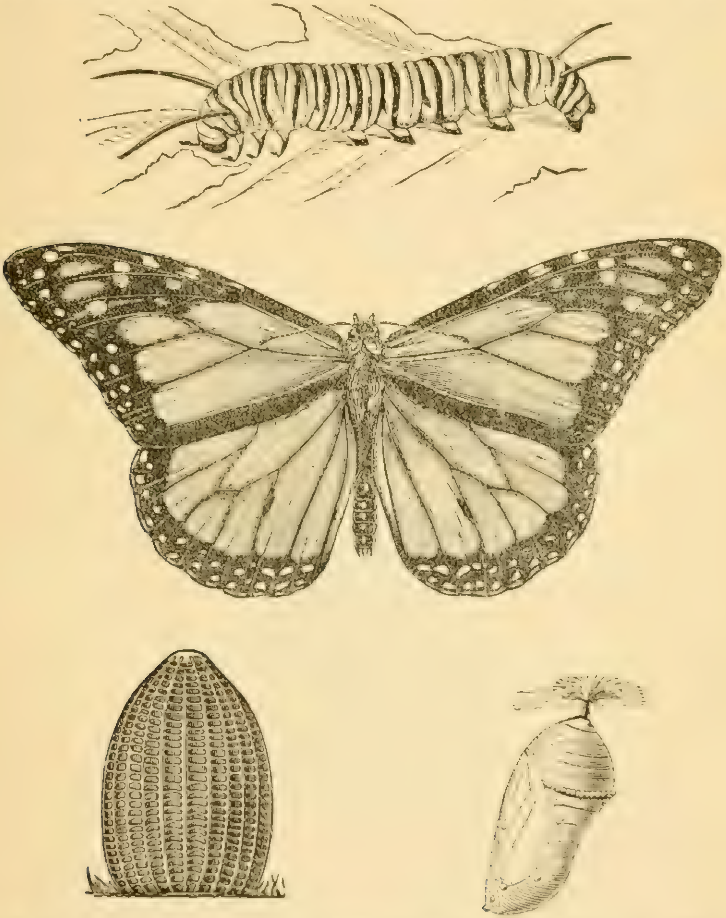


Fig. 16.—*Danais archippus* Fab.: Egg, caterpillar, pupa and adult. After Riley.

means of its hind feet to a little pad of silk, and will change to a chunky, bright-green pupa or chrysalis, marked with small golden spots, one of the most beautiful objects that can be imagined. This color gradually becomes darker, finally brown or blackish and then the butterfly will emerge. This insect is not injurious, but simply illustrated to serve as a type of the family to which it belongs. The illustrations, Figs. 12 and 16, give all the stages of this insect.

THE SPINY OR THORNY CURRANT CATERPILLAR.

(*Grapta comma* Harr.).

These peculiar caterpillars are sometimes quite numerous, denuding whole canes of the currant and gooseberry bushes. When this is the case, the plant suffers greatly and we find that the injured canes do not produce fruit in the following season. The parent of this thorny caterpillar is a very handsome butterfly (Fig. 14), also shown on plate II, Fig. 17. The wings are quite irregular in outline, having many projecting points and notches; they measure, when expanded, about one inch and a half. The surface of all four wings is reddish-brown, bordered on the outer edge with

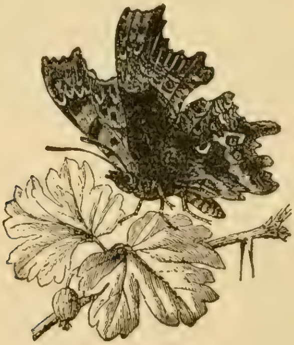


Fig. 14.—*Grapta comma* Harris. Original.

darker brown, and on the disk with brown and blackish-brown spots. The color of the hind-wings varies considerably in intensity, and this is still more so the case with the color of the underside, which is usually, however, dark-brown, with many grayish lines and streaks. A number of varieties have been described on account of these differences. But the butterfly can always be recognized from the fact that it has upon the lower surface of the hind-wings a more or less plainly marked "C" of metallic silver. From this mark the butterfly is frequently called the "C" butterfly. It passes the winter in the winged or adult state in some sheltered spot, in which it remains torpid, but awakens to fresh activity as soon as the warmth in spring imbues nature with new life. It, with some other nearly related species, can be found during the first days of spring flying about in sunny spots. Its flight is peculiar and rather jerky and swift; it darts suddenly away and as suddenly returns, occasionally resting on the sunny side of a tree, and here displaying the bright colors of the wings, somewhat dulled in intensity, however, by the influence of winter. The butterfly has the habit of exposing the entire surface of its wings as if proud of their beauty; then, again, it closes them and becomes almost invisible, as the color of the underside of the wings blends exceedingly well with the color of the bark upon which it rests; in fact, these butterflies are so well protected on this account, that when at rest it requires a keen eye to detect them at all. During the summer, when the butterflies enjoy perfect health, they sometimes seem to invite us to chase them. If one is disturbed and flies off from the spot it occupied, it is certain to return to that exact spot in a short time. The insect feeds upon any sweet fluid, but prefers the sap from any freshly wounded tree.

The eggs are usually laid singly on the leaves of the currant and gooseberries, and here the solitary caterpillars may be found. When full grown, they are about an inch and a quarter long, varying in color from a light brown to a greenish-yellow; they are marked with fine black and yellow lines. The numerous spines clothing the caterpillar are branched and differ in color, some being dark brown, others orange or yellow, the branches of the spines are frequently tipped with black. Notwithstanding the forbidding and threatening aspect of these caterpillars they can not inflict any injury to our hands. As soon as the full size has been reached, the caterpillars select some secluded spot in which to change to pupæ or chrysaldis. They spin for this purpose upon a leaf or a twig a minute pad of silk. In this little carpet the hind leg of the caterpillar are fastened, after which it hangs suspended with the head downwards. In the course of two or three days, after contracting greatly in length, the old skin is shed, and an angular looking chrysalis of a brown color appears, which is finely ornamented with silvery spots. In about ten days the butterfly appears in all its beauty.

We have in Minnesota two annual generations of this insect; the first appears late in June and the second late in August and during September.

The caterpillars of this insect feed also upon the hop, elm, nettle, false nettle and basswood, but prefer wild and cultivated gooseberries and currants.

Other closely allied species of Grapta also feed occasionally upon the cultivated currants and gooseberries, but as their habits are almost identical with that of *comma*, it is not necessary to describe them.

REMEDIES.—Hand-picking is in most cases all that is needed to keep this insect in check. In cases where we have to fight at the same time other injurious insects of the currant and gooseberry, it would be best to use a little London-purple or Paris-green. Of course none of these poisonous substances should be used at a time when the fruit is ripe or nearly ripe.

THE RED ADMIRAL.

(*Pyrameis Atalanta* Linn.).

This, like the Grapta just described, belongs to the "Angle-wings" or butterflies distinguished by having the outer margin of the fore-wings usually decidedly angular or notched, as if a piece had been cut away. This beautiful butterfly has purplish-black wings above; on the fore-wings there is a bright orange-colored band, beginning near the middle of the front margin and extending nearly to the inner angle; between this and the tip of the wing are several white spots. On the hind-wings there is also an orange band on the outer margin, enclosing a row of black spots. The

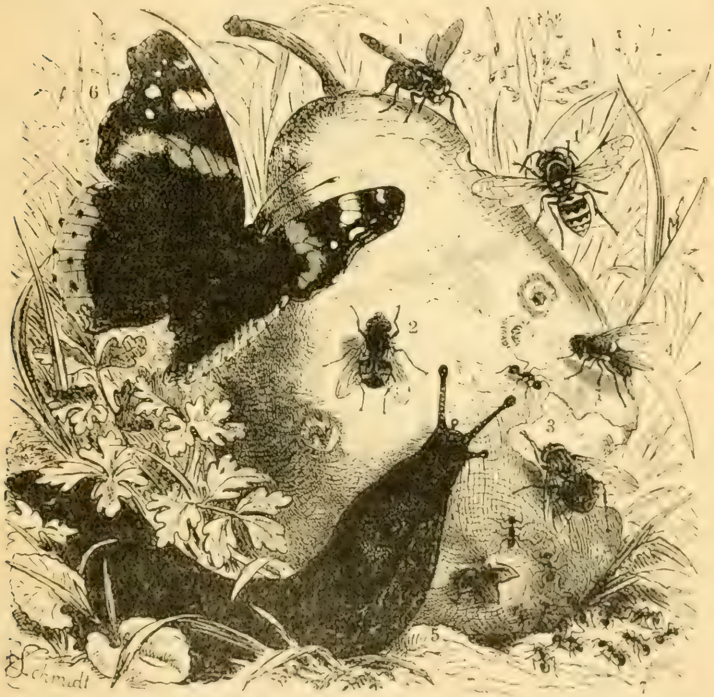


Fig. 18.—*Pyrameis atalanta*, and other insects, etc., feeding on overripe pear.

under surface of the wings is also ornamented in a similar way, but is fainter, and especially that of the lower wings resembles the bark of trees. Faintly marked upon them are the figures 98 89.

This beautiful insect feeds as a caterpillar upon the nettle and hop, but in the winged state it is a great admirer of fallen and overripe fruit. It is attracted in large numbers to fallen apples or pears, and is not slow to absorb their sweet sap with its tongue. Other butterflies are also attracted, as well as ants, flies, and wasps as shown in the illustration (Fig. 18), and even snails are fond of it.

THE URSULA OR SOVEREIGN.

(*Limenitis ursula* Fab.).

During the months of June and July we may see a most beautiful butterfly flying about cherry and plum trees, evidently in the act of depositing eggs. This medium-sized and handsome insect is of a sombre bluish-black or blackish-brown color, having the wings bordered with blue; the under-wings possess marginal rows of bluish crescents of varying size; the inner row in the female is less marked, and each crescent is supported behind by a deep orange patch or point. Several white spots occur near the tips on the upper surface of the fore-wings. All the margins of the wings are slightly crenate, the hollows being edged with white. The under side of the wings, which measure about three inches across, contain a number of large brownish spots. The females deposit eggs upon the leaves of the wild and cultivated cherries, plums, and occasionally of the apple. The mature caterpillars are about an inch and a quarter long, of an olive-green color, variegated with white, russet, reddish-yellow and ochreous. They possess two long reddish horns behind their heads, and two green tubercles on each of the other segments, with the exception of those on the fifth, which are reddish. The very strange looking chrysalis is russety, marked with white; it is suspended by its tail, and has on the middle of its back a curious and prominent projection like a Roman nose. Besides the food-plants given above, the caterpillars feed also upon the willow, scrub-oak, whortleberry and gooseberry.

The Ursula Butterfly or Red-spotted Purple is not a common insect, and the injuries caused by it are usually slight. Still it sometimes happens that for some reason this species becomes very numerous, stripping the leaves from an entire tree. The butterfly is shown in Fig. 22, plate III.

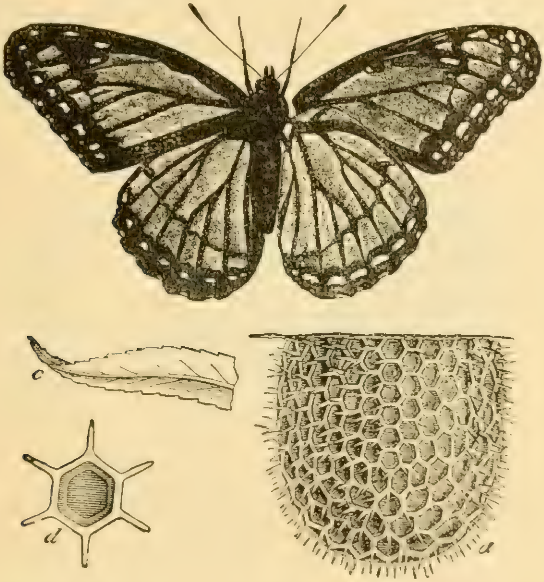


Fig. 19—*Limenitis disippus*, adult; *a*, egg, greatly enlarged; *c*, egg, natural size; *d*, one of the pits, still more enlarged. After Riley.

Further north a closely related species, the Banded Purple, is sometimes very common. Its caterpillar feeds upon the wild cherries. At Lake Vermillion the writer has seen this species, the (*Limenitis arthemis* Dru.), so numerous that during June hundreds of them could be found in the roads, where, like many other butterflies, they are attracted by liquid manure. They are so eager for this substance that they return immediately to it if driven off. The *Limenitis Arthemis* is at once distinguished from the *ursula* by the possession of a white band over each wing, upon both upper and lower surfaces. (Fig. 2, plate III).

A third species, much more common than either, is the well-known Disippus Butterfly or Viceroy (*Limenitis disippus* Godt.). The larva of this insect occurs in large numbers on our willows. Here the young caterpillar winters over in a little self-made cell or *hibernaculum* (Fig. 20, *c*). Occasionally the caterpillar is also found feeding on the leaves of the plum tree.

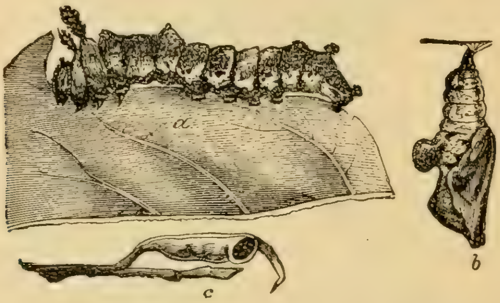


Fig. 20—*Limenitis disippus; a*, caterpillar; *b*, chrysalis; *c*, hibernaculum.

The Disippus Butterfly (Fig. 5, plate I and Fig. 19) resembles very closely the large milk-weed butterfly shown in Figs. 4 and 16, and as the latter is not eaten by birds this similarity in color and markings is a good protection, and as a result of this the Disippus is much more common than the closely allied species not thus protected. It is of a warm, orange-red color, with heavy black veins, and a black border with white spots. Fig. 20 shows the caterpillar and chrysalis of *disippus;* those of the two other species resemble them very closely.

FAMILY LYCÆNIDÆ OR GOSSAMER-WINGED BUTTERFLIES.

All members of this family are small and delicate butterflies, with slender bodies, delicate and bright-colored wings, and antennæ usually ringed with white. A very remarkable character of this family is that in the female the front legs are normal, while in the male they are shorter, without tarsal claws, and with the tarsi more or less aborted.

The caterpillars are more or less slug-like, and one of them has the peculiar habit of being carnivorous. A large number of butterflies belong to this family. Some are distinguished by their orange-red or brown colors, with a coppery reflection; others have the upper surface of their wings of a delicate blue, while still others are dark, with delicate, hair-like streaks upon the lower surface of the wings. The butterflies are, on account of these characteristics, frequently called the "Coppers," the "Blues," and the "Hair-streaks."

THE CHERRY-TREE THECLA.

(*Thecla titus* Fab.).

This delicate butterfly belongs to a small group of pretty butterflies which are very seldom seen, common as some of them are. They are best observed if we watch the flowers of the different kinds of milkweeds, but especially those of the butterfly-weed (*Asclepias tuberosa*). Many butterflies visit these showy flowers, and among them a number of different kinds of the genus *Thecla*, which are easily recognized by their jerky and erratic flight. In the northern part of the state the above-named butterfly is at times very common. It differs from our other species of *Thecla* by the absence of the hair-like tails on the hind-wings, and by the fact that the wings of the male butterfly differ in shape from those of the female. The butterfly is of a dark brown color above, with a row of seven or eight orange-colored spots near the margin of the hind wings, which are larger and more conspicuous on the under than on the upper side. The wings beneath are lighter brown, with a row of deep but bright orange spots near the hind margins of both pairs, an inner and more irregular row of small black spots, encircled with white, and on the middle of the hind-wings two similar spots, placed close together. The wings, extended, measure about an inch and a quarter across.

The caterpillars of all species of this genus are peculiar beings. That of *titus* is a curious flat creature, of a dull green color, with a yellowish tint, a patch of rose color on the anterior segments, and another larger one on the posterior extremity; the head is small and of a polished black color. The caterpillar resembles a common wood-louse or sow-bug in outline.

The chrysalis is pale-brown, and somewhat glossy, with numerous, minute, dark-brown or blackish dots over the whole surface. It is thickly covered with very short brown hairs, scarcely visible to the eye.

This interesting butterfly, illustrated in Fig. 23, plate III, occurs sometimes in large numbers towards the end of July. The caterpillars feed upon the leaves of wild and cultivated cherries, plums and oak, but they are not numerous enough to cause much damage.

THE BANDED HAIR-STREAK.

(*Thecla calanus* Hub.).

This beautiful butterfly is not common in Minnesota. The upper surface of its wings are dark brown, with brassy-green reflections. The hind-wings have two very unequal, thread-like tails, of which the lower one is the longest; it is also edged with white. The base of the fringes, from the anal angle to the lower tail, is white, and at this place there is also a narrow, white terminal line. The under side of the wings is very prettily marked, and is somewhat paler than the upper one. There are two short, whitish, parallel lines on the disk of the fore wings, and a whitish crenate line crosses the wing about half way between the last and outer borders, shadowed within by blackish; there is another broken, whitish line shaded on the outside with blackish, between the last line and the outer border. The under side of the hind-wings have two short, whitish, discal lines with a blackish shade between them. A series of blackish spots, edged on either side with whitish, crosses the wing beyond the disk; and outside of this is a series of lunate, whitish spots, shaded on the outside with blackish, and faintly edged on the outside, below, with bluish-white. Along the anal angle the black streak is followed with orange. At the very apex of the anal angle there is a black spot with white on its upper side. On the next interspace is a patch of powdery blue scales, and in the next interspace to this is an orange crescent enclosing a black spot. The orange scales are also faintly visible in the next interspace.

The caterpillar feeds on apple, oak, and other plants. The butterfly (Fig. 24, plate III) measures with expanded wings an inch and a quarter across.

THE STREAKED THECLA.

(*Thecla strigosa* Harr.).

"Upper side of the wings dark brown and unspotted in the males, but the females sometimes have a fulvous spot near the anal angle of the hind-wing and are paler in color. The under side of the wings is pale reddish-brown. The outer part of both wings is crossed by four, irregular, rather wavy, white lines, varying a little in individuals, but the two inner ones on the fore-wings approach each other towards the hinder margin. The third is shorter than the second, and the fourth or outer one, reaches only to the middle of the wing. The inner line on the hind-wings extends nearly across, then bending, runs some way up the hinder margin, preceded in the last part of its course by another nearly parallel to it. Above the termination of these two, there is a circlet of white on the margin. The outer line is short, and limited to the middle of the wing. The fore-wings have a sub-marginal row of indistinct brown lunules edged on the inside with white, and the hind-wings have a similar series, which are bright red towards the anal angle, and edged on the inner side with black followed by white, and enclosing next to the anal angle, a large black space which is nearly covered with blue scales. Beyond this is a small black spot, and there is another at the angle surmounted by a red stripe edged like the lunules, and extending up the margin. The lunules next the apex usually exhibit a few scales of red. The margins of both wings are edged with a fine whitish line.

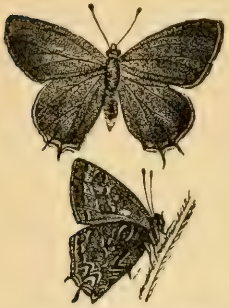


Fig. 25.—*Thecla strigosa* Harr.

"Body fuscous, beneath grayish-white. Legs, white, annulated with brown. Palpi, white, the outer joint black tipped with white. Antennæ annulated with black and white. Club, fuscous tipped with white."

The larva was taken by Mr. Saunders on a species of thorn (*Cratægus*), and his description is as follows: "Length, half an inch. Head, greenish-brown. Body, flattened, sloping abruptly at the sides. Color, velvet-green, with a darker colored dorsal stripe. The anterior edge of second segment, yellowish-brown with a few darker dots; the middle segment laterally striped with two or three faint, yellow, oblique lines, and the last two segments have each a lateral yellow patch, and there is a faint, yellow basal line from the fifth to the terminal segments. Under surface, bluish-green.

"The larva is .37 of an inch long, nearly oval, and with the head case rounded. The body is dark reddish-brown, with black markings, and thickly covered with fine hairs. The anterior segments have many black patches on them, and there is a dark ventral line from the sixth to the twelfth segments." This species is shown in Fig. 25.

FAMILY PAPILIONIDÆ OR SWALLOW-TAILED BUTTERFLIES.

This family contains the giants of the butterflies, and is well represented in our state by a number of large and bright species. The butterflies belonging here have all their legs perfect in both sexes, and the antennæ are set close together at the base. There are two groups, the first one containing such insects as the injurious cabbage-butterflies (Fig. 26), and the second one the true swallow-tails.

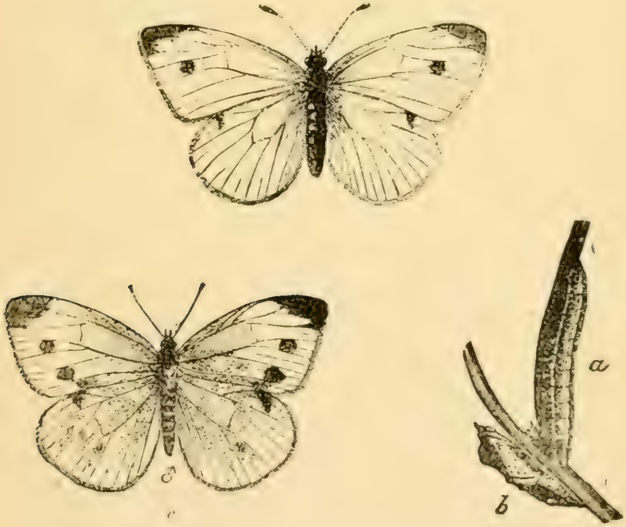


Fig. 26.—Cabbage butterflies. After Riley.

THE TURNUS SWALLOW-TAIL.

(*Papilio turnus* Linn.).

Among the numerous kinds of North American swallow-tailed butterflies few are as beautiful as this species, which leisurely sails through the warm air of June and July. It is not a common insect, excepting in the lake region of our State. In the northern part of Minnesota, but chiefly near Lake Vermillion, it occurs in countless numbers, and sometimes the shores of the lake are simply lined with a broad band of these gaudy beings. They are attracted by all sorts of putrid matter, and a dead fish seems to possess special attractions. This butterfly is, with one exception, the largest swallow-tail found in Minnesota, and measures with expanded wings four inches and more. The wings in all our specimens are a rich lemon-yellow, banded and bordered with black; on the fore-wings are four black bars, the inner one extending entirely across the wing, the outer ones becoming shorter as they approach the apex. The front margin is edged with black, and the outer-margin has a wide border of the same color, in which is a row of eight or nine spots, the lowest one being the smallest. The hind-wing is crossed with a tapering streak of black; there is also a wide black border enclosing lunar spots. Above and about these spots, and especially towards the inner angle of the wing, this border is thickly powdered with blue scales. The outer margin of the hind-wing is scalloped, and partly edged with yellow; the inner-margin is bordered with brownish-black for about two-thirds of its length, followed by a small yellow patch, which is succeeded by a larger black spot, centered with a crescent of blue atoms, and bounded below by an irregular reddish spot margined within with yellow. The hind-wings terminate in two long black tails, edged on the inside with yellow. The body is black above, margined with pale yellowish. The paler under-surface of the wings is similar to the upper one.

In Minnesota both sexes of this beautiful butterfly have a yellow ground color of the wings; but south of Pennsylvania the female usually loses this color and becomes almost black; the male, however, always retains its normal yellow color.

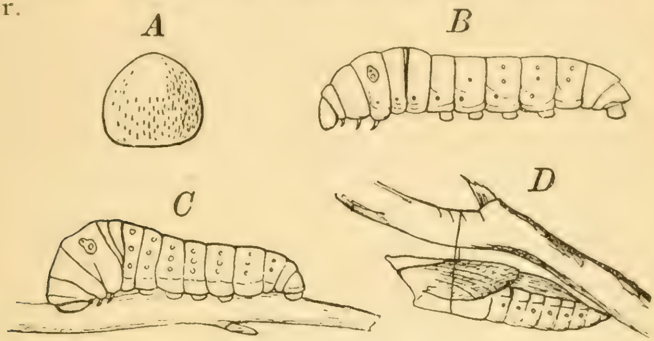


Fig. 28.—*Papilio turnus*, Linn.: *A*, egg; *B*, larva crawling; *C*, larva resting; *D*, chrysalis.

The winter is passed as a chrysalis (Fig. 28, D), which is of a dull brown color; it has a conical horn back of the head. Towards the end of May the butterflies appear; they now commence to deposit their eggs upon the leaves of apple and cherry trees; in the north they prefer the cherry and the canoe-birch for this purpose. The eggs are laid singly, and hatch in about twelve to fourteen days. The very young caterpillars are black, roughened with small brownish-black tubercles, with the first segment thickened, of a dull, glossy, flesh-color, a prominent fleshy tubercle on each side, and a patch of white on the seventh and eighth segments. Fully grown, the caterpillar is about two inches long, with a rather large reddish-brown head, and a green body, paler on the sides, which tapers posteriorly; parts of the body are covered with a whitish bloom. On the front edge of the first segment is a raised yellow fold, which slightly overhangs the head, and from which, when irritated, the caterpillar can protrude a yellow, fleshy and forked organ, which gives off a peculiar odor, disagreeable to some persons. No doubt this peculiar organ, found near the head in the caterpillars of most swallow-tails, though in caterpillars of some moths near the tail, has the office to drive off the numerous parasites always ready to pounce upon their victims. On each side of the third segment is an eye-like spot, nearly oval, yellow, enclosed by a ring of black, centered with a small elongated blue dot, which is also set in black. In some species of swallow-tails these eye-like spots look very much like eyes, and are sometimes quite startling. Another raised yellow fold occurs on the posterior portion of the fourth segment; it is bordered behind with velvety black, but is only seen when the caterpillar is in motion. Other dots occur as indicated in the illustration (Fig. 28).

Early in August, the caterpillar becomes restless and wanders about in search of a suitable spot in which to change to a chrysalis, and in which to pass the winter. When such a shelter has been found, it spins a little carpet of silk, into which it fastens the hooks of the prolegs; it then fastens a silken band or loop around the middle of its body to suspend itself. This done, it casts its larval skin and remains as a chrysalis until the following spring.

The butterfly is shown in Fig. 27, Plate IV.

FAMILY HESPERIDÆ OR SKIPPERS.

These butterflies are quite different from all the preceding ones; they differ by possessing broad heads, clothed with bristly hair, by having widely separated antennæ, the clubs of which terminate by a more or less marked and recurved slender hooklet, and by having rather small wings in comparison to the heavy bodies (Fig. 15). They are very well named, as they skip from place to place amongst low herbage. The caterpillars have unusually large heads, with strongly contracted necks; they generally make a sort of nest of a folded leaf or of several leaves. We have a large number of species in Minnesota, but none are destructive to fruit; most of the caterpillars feed upon the leaves of the various kinds of clovers, vetches and similar plants. A common species is shown on Plate IV, Fig. 29; it is the silver-spotted skipper (*Endamus tityrus* Fab.).

MOTHS.

(*Heterocera*).

FAMILY SPHINGIDÆ OR HAWK-MOTHS.

Hawk-moths are easily recognized by the form of the body, wing and antennæ. The body is very stout and spindle-shaped; the wings are long, narrow and very strong; the antennæ are more or less thickened in the middle or towards the tip, which is frequently curved back in the form of a hook; rarely are the antennæ pectinated. The tongue is usually very long, being in some instances twice as long as the body; but in one sub-family it is short and membranous. When not in use it is closely coiled like a watch-spring beneath the head.

Hawk-moths, or Humming-bird moths, have obtained these names from their habits of hovering about the flowers, and from their rapid and darting motions. Most of them appear just about dusk, flying about such deep flowers as the morning glories, primroses, petunias or others. By means of their unusually long tongues they are enabled to reach the very bottoms of these flowers in which are located the nectaries, taking this food while poised over the flower, and but rarely alighting. This attitude, and the whir of their powerful vibrating wings, gives them a strong resemblance to humming-birds, which obtain the sweet food in a similar manner. Some of the smaller and clear-winged hawk-moths fly during the broad daylight.

The caterpillars of the Sphingidæ are all external feeders, and have a cylindrical and naked body, usually with a horn near the end on the eight abdominal segment; in some cases this horn is replaced by a shining tubercle or knob. Many people are greatly afraid of such caterpillars, believing that they could inflict painful wounds with these horns, which are, however, never provided with stings. While at rest many of the caterpillars assume a very peculiar attitude, supposed to resemble the Egyptian Sphinx, hence their scientific name Sphingidæ.

THE THYSBE CLEAR-WING.

(*Hemaris thysbe* Fab.).

This beautiful insect is not as common as the closely related Bumble-bee Hawk-moth (*H. diffinis* Bdv.), the larva of which frequently strips all the foliage from our ornamental waxberry plants and honeysuckles. Both moths fly during the day and resemble very closely the common bumble-bees, both in size and general appearance. The wings of *thysbe*, which expand nearly two inches, are transparent, and crossed by dark brown veins. The fore-wings have a narrow costal border, a wide outer border dentate inwardly on the inter-spaces, and a basal patch extending along the hinder margin, of a dark, reddish-brown color, and overlaid on the basal portion with olive-green hairs. This species is readily distinguished from our other species by a line of scales dividing the discal cell lengthwise. The hind-wings are bordered all around, narrowly on the costa, more widely on the outer margin, with dark, reddish-brown, while the hinder margin and base of the wing have a very wide border of rusty red.

The trim-looking caterpillar, nearly one inch and three-fourths in length, tapering towards the head, is of a pea-green color, granulated, with dark breathing-pores; a pinkish stripe extends along the middle of the back, bordered on each side with a whitish line, which ends in front of the caudal horn. A white or yellowish line runs along each side from the second segment to the base of the horn, which is curved, light-blue, tipped with yellow, granulated with white on the sides, and black in front.

The pupa is blackish-brown, with the entire surface shagreened. The terminal spine is broad at the base, prominent, flat, rounded at the tip, and armed with some fine hooks.

The caterpillars feed upon different kinds of snow-balls, waxberry, hawthorn, apple and plum.

The adult insect is shown in Fig 30, plate V.

THE GRAPE-VINE AMPHION.

(*Amphion nessus* Cram.).

This beautiful moth (Fig. 31) is found from time to time flying about from the first to the middle of June in broad sunlight, and in this way resembling the insect just described. Specimens were caught here as late as the beginning of August.

The moth, which expands from one inch and three-fourths to two inches, has the upper side of head, thorax, abdomen and fore-wings of a dull, dark, rusty-brown color. The middle of the fore-wings is crossed by a rich, dark-brown oblique band, within which are two lines of the same color; beyond the central band is another line followed by several spots of the same color. None of the markings are clearly defined. The fringes are of the same color as the wings, except at the middle of the excavations, where they are pale yellow. The hind-wings are of a rich, dark brown color, with an oblique, central reddish band: the fringes are pale yellow, spotted with brown.

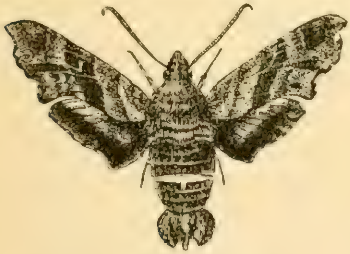


Fig. 31.—*Amphion nessus* Cram.
After Beutenmueller.

The caterpillar, which feeds upon the grape-vine, Virginia creeper, Epilobium, and some other plants, measures over two inches in length; it tapers greatly from the fourth segment to the head, but there is a slight enlargement of the third and fourth segments which increases with every moult. It is of a uniform pale yellowish-green color, or chocolate-brown, dotted with numerous dark-umber points, but especially along the dorsal line; two light longitudinal subdorsal lines extend straight from the head to the eleventh segment, thence curving to the caudal horn. There are also eight lateral or stigmatal stripes of dark umber; the caudal horn is very short, black-ochre or reddish-brown at the base, tapering abruptly, and often carried in a line with the back. The caterpillar is rather sluggish; at rest it stretches itself at full length along the leaf or leaf-stem, very much like the larva of the Abbot Spinx described later. When full grown it transforms to a dark-brown pupa under the rubbish on top of the ground.

THE ABBOT SPINX.

(*Thyreus Abbotii* Swains.).

This interesting insect is not common in Minnesota, but occurs only occasionally upon our cultivated and wild grapes, as well as upon the Virginia creeper. The caterpillar reaches its full size early in August, when it measures almost two inches in length. It varies considerably in color and appearance. Usually it is of a dull yellow or reddish-brown, each segment being marked transversely with six or seven fine black lines, and longitudinally with dark brown patches, giving the caterpillar a checkered appearance. The under side of the caterpillar is yellowish, with a pinkish tinge between the prolegs. The head is slightly roughened and dark, with a lighter broad band each side, and a central x-shaped mark down the middle. This caterpillar does not possess the usual caudal horn like the other larva of the Sphingidæ, having in its place a polished black tubercle, ringed with yellow; nor does it assume the usual attitude of a shinx by holding up the head, but rests stretched out at full length upon a twig. If disturbed it will throw its head from side to side, producing at the same time a crepitating sound.

The pupa is formed most frequently in a little cavity on the surface of the ground, or is simply hidden under a few dead leaves or other rubbish loosely fastened together with threads of silk, in which are mixed grains of earth. The pupa, about an inch and a quarter long, is of a blackish or dark brown color, roughened by confluent punctures, but between the lighter colored joints it is smooth. The head-case is broad and rounded; the tongue-case does not project; and the tail terminates in a rough, flattened and wedge-shaped point, from which extend two minute horns.

The adult insect remains in the ground until the following spring, hence we have but a single annual generation. The peculiar moth, measuring with expanded wings about two and a half inches across, is of a dull chocolate or grayish-brown color. The front-wings are lighter beyond the middle, and are variegated with brown. The hind-wings are sulphur-yellow, with a broad, dark brown border breaking into a series of short lines on a flesh-colored ground as it approaches the body. The wings are very deeply scalloped, especially the front ones. The body, which is curved upwards when the insect is at rest, is furnished with tufts along the sides near the extremity. If the insect should ever become common, it is easily kept in check by hand-picking. A number of small parasites seem to make it their business to keep it from increasing.

This insect is shown in Fig. 32, Plate V.

Deidemia inscripta Harris.

This is a very uncommon hawk-moth, not alone in Minnesota but everywhere, and although it feeds as a caterpillar on the grape-vine and Virginia-creeper, it is not apt to become injurious. This caterpillar is about two inches long, of a fine green color; its caudal horn is whitish at the tip; the head is small and the body tapers from the third segment towards the head. It enters the ground late in June or in the beginning of July for pupation, but not very deeply, and here it remains until the middle of May, when the moth emerges; there is but a single annual brood.

The moth, which expands a little less than two inches, has an ashen-gray head and body; the thorax is shaded with brown, and there are two rows of dark brown spots on the abdomen. The last segment is trifurcated; the antennæ are serrated in the male, simple in the female. The fore-wings have the same color as the body, with bands and marks of rich brown of various shades; there is a pale discal spot, and also a small triangular spot near the exterior margin. The hind-wings are reddish, or reddish-brown, with darker outer margins. The under side of the wings is ashen-gray, with darker borders; the small triangular white spot on the upper surface near the outer edge of fore-wings is repeated.

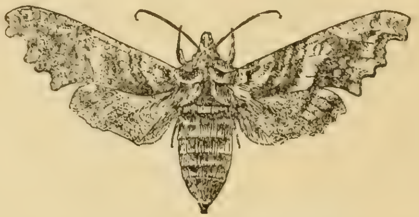


Fig. 33.—*Deidemia inscripta* Harr. After Beutenmueller.

This rare moth is shown in Fig. 33.

THE WHITE-LINED MORNING-SPHINX.

(*Deilephila lineata* Fab.).

This very beautiful moth is quite common in Minnesota, and would cause much more injury to our cultivated grapevines if it did not prefer the common purslane for food, to which it is quite welcome. The moth may often be seen at dusk flying from flower to flower. It resembles in its flight a humming-bird, especially if it hovers over some flower and pushes its long tongue into the same to extract the sweet nectar found in it. The humming-sound, similar to that produced by the flight of a humming-bird, is produced by the rapid motion of the wings.

The ground-color of the fore-wings of this hawk-moth is a rich greenish-olive, with a pale-buff stripe or bar extending along the middle of the wing from the base to near the tip; along the outer margin there is another band nearly equal in width, but of a grayish color; the veins are margined with white. The hind-wings, which are quite small, are of a roseate color, and are marked above and below by an almost black band; the lower margin is fringed with white. On the body there is a line of white on each side, extending from the head to the base of the thorax, where it unites with another line of the same color, which extends down the middle, and dividing, sends a branch to each side. The greenish-olive abdomen has interrupted bands of white and black, as shown in the illustration Fig. 36, Plate VI. The wings of this fine moth expand about three inches and a half.

This insect is double brooded in Minnesota, appearing on the wing in June and again in September. It seems as if an attempt was made to produce still another brood, as not infrequently the moths are found very late; Sept. 28 and Oct. 14 are dates of late captures.

This moth has a very wide geographical range, being not alone found throughout the United States, but also in Canada, West Indies, Mexico and Southern Europe, where it is called (*D. livornia*). Its caterpillar is a rather general feeder, having been found upon the grape, apple, watermelon, buckwheat, turnip and purslane; the latter is the plant preferred, however. It is not uncommonly found as late as September, even up to frost. When mature, the caterpillar enters the earth, where it forms a smooth cavity, inside of which it transforms to a light-brown pupa. The caterpillars vary very much indeed, so much so that extreme forms of it do not resemble each other in the least. The most common form is yellowish-green, with a prominent sub-dorsal row of elliptical spots, each spot consisting of two curved black lines inclosing a bright crimson space and a pale yellow line; all the spots are connected by a pale yellow stripe, edged above with black (Fig. 34). The other common form is black, distinguished chiefly by a narrow yellow line along the back, and a series of paler and darker yellow spots (Fig. 35). Both forms are subject to great variation.

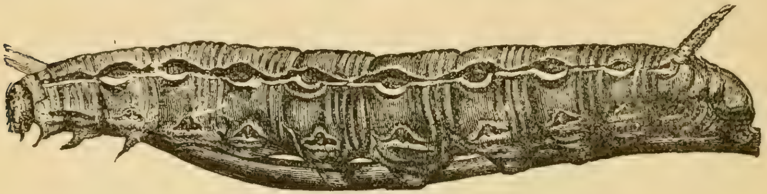


Fig. 34.—*Deilephila lineata* Fab., caterpillar.

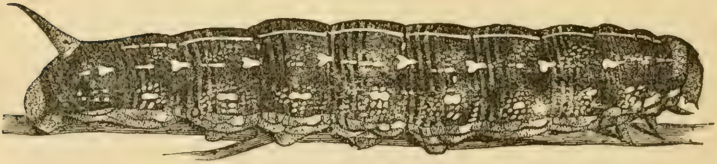


Fig. 35.—*Deilephila lineata* Fab., caterpillar.

These rather beautiful caterpillars are sometimes exceedingly numerous, and people are apt to become scared on their account. When army worms and migratory locusts have denuded fields of almost all plants, only the purslane is left in undisturbed possession of such fields, not having been eaten by either of the above insects, and having now an opportunity to spread, this weed is not slow to do so, and in this way a large amount of food is offered to and accepted by this insect. But an increased number of caterpillars is soon followed by an increased number of parasites, from which this species of moths suffers greatly. A two-winged fly, a species of *Tachina*, destroys large numbers of the larva, and it is often quite difficult to find a single caterpillar that does not show the cream-white eggs of this parasite.

THE DARK-VEINED MORNING SPHINX.

(*Deilephila galii var. chamænerii* Harr.).

This is a closely allied species, but smaller and not as common, though by no means a very rare insect. Its larva has also been found feeding upon the leaves of the grapevine, but it prefers those of plants belonging to the genera *Galium* and *Epilobium*. Other plants are also eaten. The moth has the same greenish-olive color as *lineata*, and almost the same stripes and markings. The central band on the fore-wings in this species is wider and more irregular; the thorax lacks the white markings on the disk, and the veins are not lined with white. The hind-wings in both species are almost identical in coloration and markings. This insect is quite common in Europe, and the form found here hardly deserves the name of a variety. It is shown in Fig. 37, Plate V.

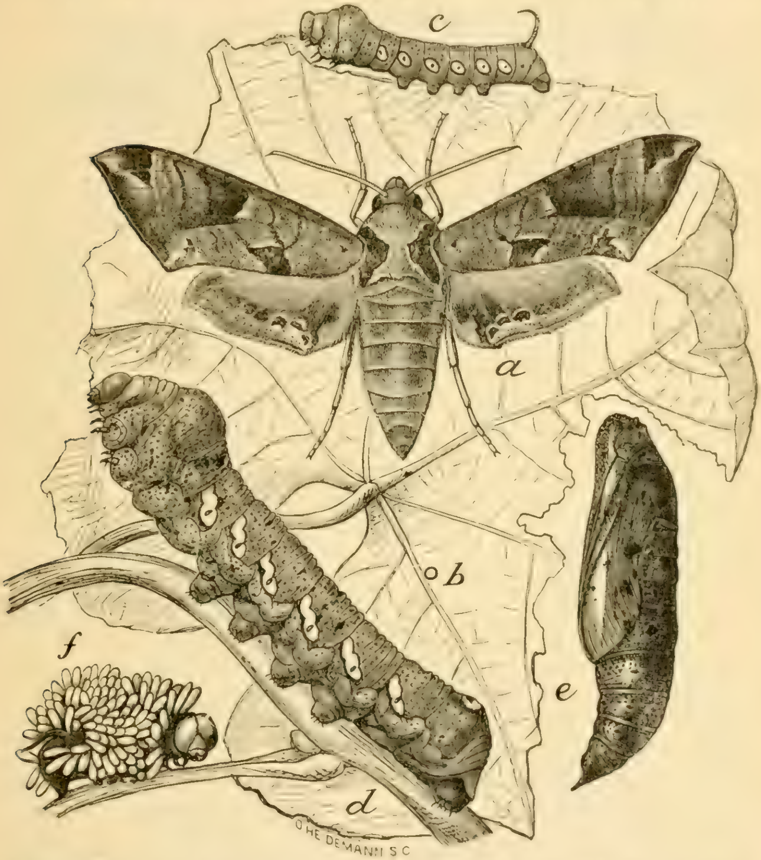
The caterpillar, measuring about two and a half to three inches in length, has a small dull-red head, with a black stripe across the front at base. The body is deep olive-green, polished, with a pale yellow line along the back, terminating at the base of the caudal horn; on each segment, from the third to the twelfth, is a pale yellow spot on each side, about half way between the dorsal line and the breathing-pores, largest on the segments from the sixth to the eleventh; the spot on the twelfth segment is elongated, and, extending upwards, terminates at the base of the horn. The yellow spots are placed in a wide but indistinct blackish band, and the sides of the body below the spots are thickly sprinkled with minute, raised, yellow dots. The under surface is pale pinkish-green; the feet are black; the prolegs pink; with a patch of black on the outside of each.

THE ACHEMON SPHINX.

(*Philampelus achemon* Drury).

Among the fifty or more larvæ of moths that feed upon the foliage of the grape, we have some ten species of hawk-moths, all of which are widely distributed. Some of them are rare, but others will occasionally become quite destructive. The best known of all is the caterpillar of the above-named Sphinx, which frequently devours all the foliage of the Virginia creepers, and strips whole canes of the grape. Being quite large it is readily seen, and it is always a case of gross negligence if such a large insect is not discovered and removed. In nurseries the damage is frequently very great, as one of the large caterpillars can kill numerous young vines in a short time. Hand-picking is in all cases the most simple and satisfactory remedy.

The full grown caterpillar of this insect is usually found towards the latter part of August and early in September. It is a large larva, measuring almost four inches when crawling; at rest it measures much less, as the first two smaller segments are partly withdrawn in the much larger third segment. The caterpillar varies in color from pale straw-color to reddish-brown, the color growing darker and deep-brown towards the under side. An interrupted line of brown runs along the back, and another unbroken one extends along each side; below this latter are six scalloped cream-colored spots, one on each segment, from the sixth to the eleventh. The much wrinkled body is dotted with minute spots, which are dark on the back but lighter and annulated at the sides. Head, thoracic segments, and spiracles are suffused with flesh-color; the prolegs and caudal-plates are brown. When this caterpillar is ready to change to a pupa it changes to a beautiful pink or crimson color. The young larva is green, with a long and slender horn rising from the eleventh segment and curving over the back. In the older and fully grown specimens this long horn has disappeared, and in its place is found a highly polished lenticular tubercle.


c
a
b
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e
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O HE DEMANN S C

Fig. 38.—*Philampelus achemon* Drury. *a*, moth; *b*, egg; *c*, young larva; *d*, mature larva; *e*, pupa; *f*, parasitized larva—all natural size. From Div. of Entomology, Department of Agriculture.

The large pupa is formed in a smooth cell several inches below the surface of the ground; it is of a dark, shining mahogany color, shagreened or roughened, especially at the anterior edge of the segments on the back, and terminates in a short, blunt spine. This species is single brooded, and the pupa remains in the ground until late in June of the following year, though in some cases the moth has appeared the same season.

The fine looking moth is brownish-gray, variegated with light brown, and with deep brown spots. The hind-wings are pink, with a dark shade across the middle, still darker spots below this shade, and a broad gray band behind. The heavy reddish-gray body is marked with two dark brown triangular patches on the thorax, which are finely edged with white. The posterior edges of all the segments of the body are also edged with white.

This showy insect is found throughout the United States and Canada, or wherever the grape is cultivated, or where the Virginia creeper is utilized to decorate our dwelling places.

The illustration (Figs. 38) shows the different states of this insect; the adult and caterpillar is also shown in Figs. 39 and 40 on Plate VII.

THE PANDORUS SPHINX.

(*Philampelus pandorus* Hbn.).

One of the most beautiful moths found in the United States is the Pandorus Sphinx. It is not common in Minnesota, but occurs here, as several specimens have been seen that were captured in our State. The moths, with wings fully expanded, measure from four to four and a half inches across; they are of a light olive color, mixed with gray, and varied with patches of a darker olive-green, rich and velvety, and some portions, especially on the hind-wings, are of a rosy hue. The body is pale greenish-brown, ornamented with dark olive patches. The moths appear in July, when, after pairing, the female deposits her eggs singly on the leaves of the grape-vine and Virginia creeper (*Ampelopsis quinquefolia*), where they shortly hatch, producing small green larvæ of a pinkish hue along the sides and with a very long pink horn at the tail (Fig. 41). As the caterpillars increase in size the horn becomes shorter, and after a time curves round. As the larva approaches maturity, it changes to a reddish-brown color, and after a third moult loses the caudal horn, which is replaced by a glassy, eye-like spot. The mature larva, when in motion, will measure nearly four inches in length, but when at rest it draws the head and two adjoining segments within the third, which shortens its body nearly an inch, giving it a very odd appearance, with its anterior portion so blunt and thick. It is of a rich reddish-brown color, of a lighter shade along the back, with five nearly oval cream-colored spots along each side from the seventh to the eleventh segments inclusive. On the anterior segments there are a number of black dots; a dark, polished, raised, eye-like spot in place of the tail; the breathing-pores along the sides black, showing prominently in the cream-colored spots. It is a very voracious feeder,

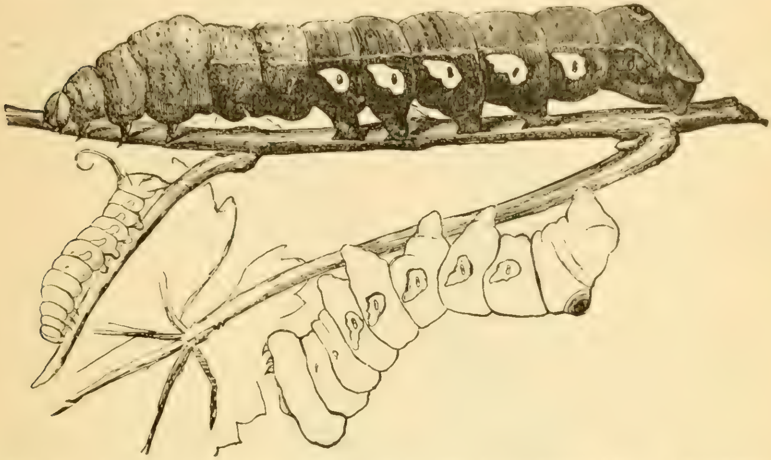


Fig. 41.—*Philampelus pandorus* Hbn. Caterpillars of different ages. After Riley.

and strips the vine of its leaves with such rapidity that it soon attracts attention. When full grown it descends from the vine and buries itself in the ground, where it forms an oval cell, within which it changes to a pupa. This pupa is of a chestnut-brown color, with the segments roughened with impressed points, the terminal joint having a long, thick spine. The insect remains in the pupal state until the following summer, but occasionally it matures and escapes the same season. The moth is shown in Fig. 42, Plate VII.

THE HOG-CATERPILLAR OF THE GRAPE.

(*Ampelophaga myron* Cram.).

This common caterpillar, also called the "Green Grapevine Sphinx," is the most destructive of the horned caterpillars found feeding upon the foliage of the grape. It is called the Green Grape-vine Sphinx because the moth, which expands about two and a half inches across the wings, has the fore-wings of a dark olive-green color, crossed by bands and streaks of greenish-gray, and shaded on the outer-margin with the same hue; its hind-wings are dull red, with a patch of greenish-gray next the body, shaded gradually into the surrounding color. On the under side the red appears on the fore-wings, the hinder pair being greenish-gray. The antennæ are dull white above, rosy below; head and shoulder-covers deep olive-green, the rest of the body of a paler shade of green; underneath the body is dull gray. The moth is shown in Fig. 43, Plate VI.

It rests quietly during the day, takes wing at dusk, and is very active, having a swift and strong flight. It darts rapidly from flower to flower, and is not readily captured, as it is a wide-awake insect. Large numbers are attracted to the electric lights, and the moths fly enormously long distances to it, otherwise they could not be found at this light in our prairie villages, and in places where neither grapevines nor Virginia creepers are grown.

The caterpillars consume a very large amount of food, and a very few of them are capable of stripping a small vine of its foliage in the course of two or three days. They possess the additional bad habit of gnawing into the stems of the clusters of the grapes, which either wilt or drop off.

The eggs, which are 0.05 inch in diameter, perfectly round, and of a uniform delicate yellowish-green color, hatch into pale green worms with long and straight horns at the tails. After feeding from four to five weeks they reach their full size, and the horns look now comparatively short, with a posterior curve. The full grown (Fig. 44) caterpillar is distinguished by having the third and fourth segments immensely swollen, while the first and second ones are quite small and retractile. According to Prof. Riley it is from this peculiar appearance of the fore part of the body, which strikingly suggests the fat cheeks and shoulders and small head of a blooded hog, that it is known as the "Hog-caterpillar." Perhaps an equally good explanation for having this name is the great appetite possessed by such worms. The color of a grown caterpillar is pea-green; it is wrinkled transversely, and covered with numerous pale yellow dots, placed

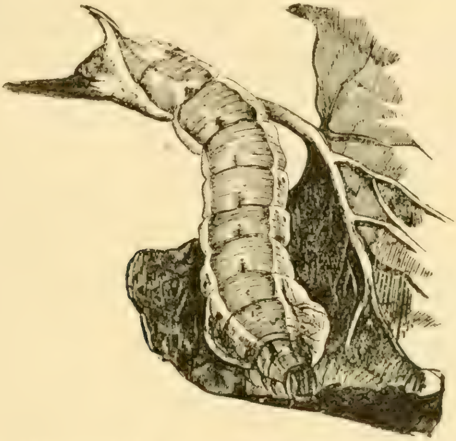


Fig. 44.—*Ampelophaga myron* Cram., caterpillar. After Riley.

in irregular transverse rows. An oblique cream-colored lateral band, bordered below with darker green, and most distinct on the middle segments, connects with a cream-colored sub-dorsal line, which is bordered above with darker green, and which extends from the head to the horn at the tail. There are five and often six somewhat pale yellow triangular patches along the back, each containing a lozenge-shaped lilac-colored spot. The head is small, with yellow granulations, and four perpendicular lines, and the spiracles or breathing-holes are orange-brown. The caterpillars vary considerably in coloration, especially those of the second brood, where the green is often replaced by a delicate reddish-pink, with markings of darker shades of red and brown. When full grown the caterpillar descends from the vine, and among old leaves or any other rubbish lying on the ground it forms a mesh of strong brown silk, within which it changes to a pupa (Fig. 45), which is of a pale brown color, speckled and spotted with brown, but chiefly characterized by conspicuous dark brown spiracles and broad brown incisures of the three larger abdominal segments.

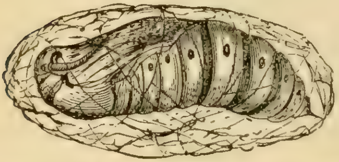


Fig. 45.—*Ampelophaga myron* Cram., pupa. After Riley.

The moths of the first brood appear during May; those of the second late in July. The insect passes the winter in the pupal state.

The best method to dispose of these pests is to pick them off the vines, and as the worms are readily detected by the ravages they cause this remedy is very simple. Though frequently very numerous, their numbers are kept in check by several parasitic insects. It is not uncommon to see one of these caterpillars covered with snow-white cocoons of a minute wasp (Fig. 46). These co-

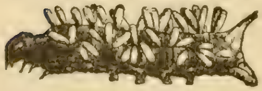


Fig. 46.—*Ampelophaga myron* Cram., caterpillar parasitized.

coons are frequently mistaken by those not well posted in such matters for the eggs of the caterpillars themselves. Of course this is a mistake, as caterpillars are not in the habit of laying eggs. If the poor victim of these parasites, which can no longer take any food, is kept in a glass, we shall soon see what will become of those reputed eggs. Before very long we shall see that a very minute wasp (Fig. 47) pushes open a little lid, which it had previously cut with its jaws, and flies off, happy to be liberated from its narrow cell. As all caterpillars attacked by these parasites succumb in the end, and never transform to pupæ, it is well to recollect that worms carrying such egg-like cocoons should be left alone, and should by no means be destroyed. The small wasps issuing from these cocoons have nothing else to do but to search for other caterpillars in which to deposit their eggs, hence they are employed in very good work.

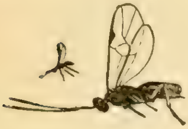


Fig 47.—*Parasite.*

THE PLUM-TREE SPHINX.

(*Sphinx drupiferarum* S. & A.).

Like all the members of the Sphinx moths, the above insect possesses a robust body, and long and narrow wings moved by powerful muscles, which enable it to fly rapidly over long distances. This accounts for the fact that they are found frequently at electric lights many miles away from their place of birth.

The Plum-tree Sphinx (Fig. 48, Plate VI) is a handsome insect, but quite different from those described before, as it lacks their bright colors. The moth, which appears during June, has an expanse of wings measuring from three and a half to four inches. The wings are of purplish-brown color; the fore-wings have a stripe of white on their anterior edge, and one of a fawn-color on their outer one; there are also three or four oblique black streaks, and a black dot on the white stripe. The hind-wing has two whitish, wavy stripes, and a fawn-colored one on the outer edge. The head and thorax are blackish-brown, with a whitish-fawn color at the sides; the eyes are very prominent; the snout-like projection in front consists of the two palpi, within which lies the tongue, snugly coiled up like the spring of a watch. This tongue is as long as the body and is used by the insect in extracting nectar from flowers. The body is brown, with a central line and a band on either side of black, the latter containing four or five dingy-white spots. The insect is quite common in Minnesota, as indicated by the large number of moths attracted to the electric light. Even as far north as Duluth the insects occur in fairly large numbers.

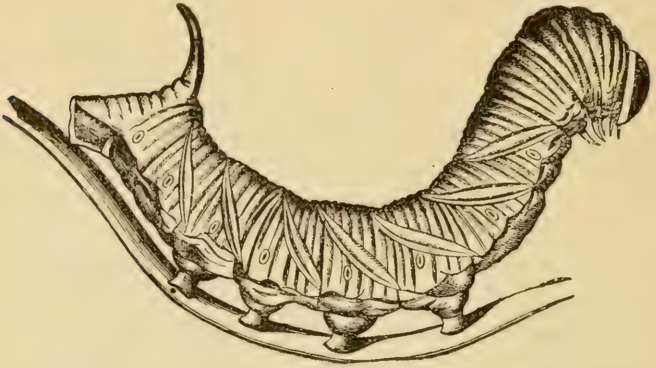


Fig. 49.—*Sphinx drupiferarum* S. & A.; caterpillar. After Saunders.

The eggs are laid singly on the leaves of the plum. They are of a pale yellowish-green color, smooth, slightly oval, and about one-fifteenth of an inch long. In about eight days the young caterpillar eats its way out through the side of the egg; the shell itself is usually eaten in part or entire. The young larva is of a pale yellowish-green color, with a few slightly elevated whitish tubercles on every segment, from each of which arises a single short hair; the caudal horn is dark. When full grown the caterpillar (Fig. 49) is about three and a half inches long, of a beautiful apple-green color, and with a lateral dark-brown or blackish stripe. On each side of the body there are seven broad, oblique, white bands, bordered in front with light purple. The breathing-pores are of a bright orange-yellow; the dark-brown horn is quite long and has a yellowish tint about the base at the sides.

When not feeding this larva assumes the peculiar rigid position that has given this class of caterpillars the name of "Sphinx." It is quite a formidable looking insect, but is perfectly harmless and can be handled with impunity. As soon as fully grown, it enters the ground, where at the depth of several inches it prepares a large and smooth cell, lined with some sort of water-proof cement, and there it changes to a reddish-brown pupa, about an inch and a half long, and with a short, thick and projecting tongue-case (Fig. 50). The pupa remains in the ground until the following June.

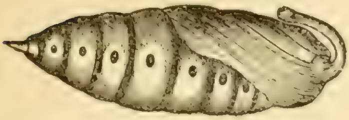


Fig 50.—*Sphinx drupiferarum* S. & A.; pupa.

Like all worms of this kind they soon show their presence upon plum trees by the denuded twigs, and a vigilant fruit-grower should not be slow to find and exterminate this foe. Sometimes these caterpillars cause considerable damage in nurseries, and if found in large numbers, as is sometimes the case, many young plum trees are killed.

THE APPLE SPHINX.

(*Sphinx gordius* Cram.).

This moth (Fig. 51, Plate VI), which expands from three to three and a half inches across the wings, is also found in Minnesota, but seems to be rather uncommon. It is found from late in May to the end of June. Its fore-wings are dark brown, varied with ash-gray, with black streaks within the veins, and a white dot near the middle, resting on a long black line. The hind-wings are gray; a band across the middle, and a wide marginal band are black. The fringes of the wings are white, the head and thorax blackish-brown. The abdomen is dark-gray, with a central black line, and alternate black and grayish bands partly encircling it.

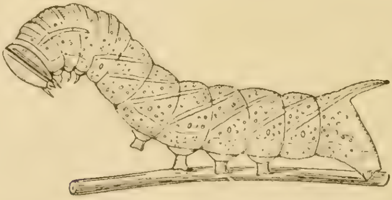
The caterpillar of the Apple Sphinx, like most others of this family, is thick, cylindrical and apple-green, about two and a half inches long, with a reddish-brown horn projecting from the hinder part of its back, and with seven oblique stripes along each side, of a violet color, margined behind with white. This caterpillar also enters the earth for pupation, and changes to a brown pupa with a short projecting tongue-case. The insect winters as a pupa.

Hand-picking is all that is needed to keep this insect in check.

THE BLIND-EYED SPHINX.

(*Paonias excæcatus* S. & A.).

Among the numerous caterpillars that infest apple trees, we find sometimes a thick and cylindrical worm, about two and a half inches long, which differs from all those mentioned thus far by having a green and triangular head, bordered with white. Its body is of an apple-green color, paler on the back but deeper along the sides. Its skin is roughened with numerous white-tipped granulations; the caudal horn



Fig, 52.—Paonias excæcatus S. & A.; caterpillar.

is bluish; seven oblique stripes, of a pale yellowish-white color, are found on each side of the worm, the last one of a brighter yellow than the others, and extending to the base of the horn (Fig. 52). The caterpillar enters the earth for pupation and changes to a chestnut-brown smooth pupa, with a short terminal spine.

The moth (Fig. 53, Plate VIII) appears from May to July, but chiefly in June. It is a very handsome insect. Its body is fawn-colored; on the top of the thorax is a chestnut-colored stripe, and on the abdomen a dark-brown line. The front-wings are fawn-colored, or rich brown, clouded and striped with two broad bands of lilac-gray; the hind-wings are rose-colored in the middle, with a brownish patch at the tips, crossed by two or three short whitish lines, and having near the inner angle a black spot with a pale blue center. The antennæ of the male are pectinated beneath. The moths measure with expanded wings about three inches across.

This and some other closely allied moths have very short, scarcely visible tongues, and their fore-wings are generally scalloped on the outer edge. When at rest, the anterior portion of the hind-wings projects beyond the front-wings, and the abdomen is usually turned upwards. In this position the highly-colored eye spots are no longer visible, and the insect resembles very closely a dead leaf.

This insect is by no means a rare one in Minnesota. Its larva is found on the apple tree and also on the plum and wild cherry, but it prefers the smaller oaks. It causes but little damage to our fruit trees. The caterpillars are not readily seen, as they assume during the day a rigid and sphinx-like position, but they make their presence readily visible by defoliating whole branches.

THE PURBLIND SPHINX.

(*Paonias myops* S. & A.).

This is another moth closely allied to the preceding one. It is somewhat smaller, measuring, when the wings are expanded, about two and a half inches across. It is very handsome, and much brighter than the *excæcatus* (Fig. 54, Plate VIII). It has a chocolate-brown head and thorax, with a purplish tinge; the thorax has a tawny-yellow stripe down the middle; the abdomen is brown, with dull yellowish spots. The fore-wings are chocolate-brown, with black bands and patches. The hind-wings are dull yellow, with the outer half chocolate-brown; an eye-like spot is found towards the inner margin; it is black with a large pale blue center. When at rest this moth is also thoroughly well protected by its position and color, which unite to give it the appearance of a dead leaf.

The caterpillar of this moth occurs on the cherry tree, but is uncommon. Since the electric lights have been introduced the moths are seen more frequently. The caterpillar is found during August; it is a large, cylindrical green worm, about two inches long, with a curved horn at the end of the body. Its head is bluish-green, with a bright yellow line on the sides; the body is green, with a row of reddish-brown spots on each side of the back, and another similar row down near the breathing pores. Along each side there are six oblique, bright yellow bands, and two short yellow lines on the anterior segments. The horn is green, tinted with yellow at the sides. When full grown the caterpillar enters the earth, where it changes to a dark brown pupa, which remains in the ground until the following June or July, when the perfect insect escapes.

The caterpillar is not common enough to cause great injury to cherry trees, and as it can be readily detected by its work it is easily kept in check.

THE COMMON DOUBLE-EYED SPHINX.

(*Smerinthus geminatus* Say).

This is one of the most common species of hawk-moths found in Minnesota. The caterpillars feed upon a variety of plants, such as the apple, plum, ash, willow, birch and others.

The mature caterpillar is about two and a fourth inches long, of an apple-green color, somewhat lighter above, with pale green or whitish granulations over the surface. Its head has a yellow stripe on each side, and there are seven oblique stripes on each side of the body, of a pale yellow color, except the last one, which is bright yellow. There is also a stripe on the side of the forward segments. The anal shield and plates are granulated and of a darker green than the rest of the upper surface, but of the same color as the under surface. The caudal horn is slightly curved, of a violet color and granulated (Fernald). It is not an uncommon occurrence to find some of these green worms marked with a series of bright red spots along their sides, as shown in Fig. 55, Plate XV.

The moth (Fig. 56, Plate VIII), which expands two and a half inches, has a pale gray head and thorax; in the middle of the latter is a rich, dark brown triangular spot, which is rounded in front and widened out behind. Both abdomen and under side of body are brownish-gray. The gray forewings have a rosy tint in some examples; the discal spot is whitish, bordered with dark brown, and a dark brown line, edged on the inside with white, starts from the basal third of the costa at right angles with it, and runs about half way across the wing, where it forms nearly a right angle, and then runs across to the hinder margin. The lower part of this line is wider, and shades off on the outer side. A broad, dark-brown, oblique stripe starts at this line and ends at a narrow, wavy, pale band, which crosses the outer part of the wing; within it is a darker band with a still darker straight inner edge. Outside of the pale band are several indistinct lines crossing the wing, a dark brown spot just inside of the anal angle and a lunulate spot of the same color edged on the inside with white. The hind-wings are rosy red, with gray costal and outer borders. There is a large black spot with two blue spots on it near the anal angle, and connected with it by a narrow, black stripe. Occasionally a third blue spot appears, but sometimes there is but a single one.

The globose eggs are somewhat flattened, and of a pale green color.

THE WALNUT SPHINX.

(*Cressonia juglandis* S. & A.).

This is still another Sphinx closely related to the preceding species, but quite different from them, as it lacks the bright eye-like spot upon the hind-wings. The moth, which expands two and a half to three inches, is uniformly light brown or pale lilac-gray (Fig. 57, Plate VIII). The fore-wings are somewhat clouded with brown in the outer part and also through the middle. Near the outer margin are two fine parallel lines, about a tenth of an inch apart, that cross both the fore and hind-wings; near the body are two similar lines which cross only the fore-wings and enclose a square dark-brown spot adjacent to the middle of the inner margin. The females are much larger, and of a lighter brownish-gray color than the males, with the square spot on the fore-wings less distinct. The antennæ are pectinated beneath in the male.

The caterpillar is of a pale brownish-green color, with a long caudal horn. It has a small head, and the body is attenuated before and behind; there is a row of sub-dorsal and stigmatal reddish-brown spots, and seven oblique, lateral, bright yellow bands, When disturbed it makes a creaking noise by rubbing together the joints of the fore-part of the body. It enters the earth to transform into a pupa.

This insect is very uncommon in Minnesota, but has been found as far north as Duluth, though none of its food plants, viz., walnut and hickory, grow in that region, which indicates that its caterpillar must also be able to subsist upon other food. If ever it should become numerous in nurseries and wind-breaks, or wherever walnuts or hickories are grown, it can readily be kept in check.

FAMILY SESIIDÆ OR CLEAR-WINGED MOTHS.

There is, perhaps, no other family of moths so well separated from all other families as that of the Sesiidæ. They are all small, with slender bodies; they fly only by day, and frequently in the brightest sunshine. Their larvæ are borers; the caudal horn is absent, and in consequence of their mining habits their colors are uniformly yellowish-white, and only head and legs are darker. Many of the species of moths belonging here are very beautiful, and most of them are remarkable on account of the protective mimicry exhibited by them. This close resemblance to insects of different orders was observed long before the significance of protective mimicry was understood. The majority of the Sesiidæ mimic bees, wasps and flies. We all know from experience that bees and wasps can advance some very pointed arguments to be left alone, and any other insect that closely mimics such well armed warriors is very apt to be left unmolested. This mimicry is not simply a superficial one, since even their motions, if captured or disturbed, are like those of the insects imitated. Their attitude when resting, the sounds they produce, their hyaline wings, their ringed body, even the odor they give off, all are apt to warn us and to caution us. Yet though they pretend to sting they lack the necessary organ for that purpose.

Their larvæ, being miners, are destructive to the shrubs and trees they infest. Some bore through solid wood; others prefer the pith of woody stems; others are found just under the bark, while still others enter the roots of plants.

THE NATIVE CURRANT-BORER.

(*Alcathœ caudatum* H. Edw.).

Although no specimens of this interesting species have been captured, their work has been noticed several times; the larvæ of it infest the wild species of currants.

THE RASPBERRY ROOT-BORER.

(*Bembecina marginata* Harr.).

This insect resembles a wasp, and most persons would not dare to touch it on that account. Its front-wings are transparent, veined with black or brownish, and heavily margined with reddish-brown. The hind-wings are also transparent, and fringed with dark-brown. The body is black, banded and marked with golden-yellow. The wings measure almost an inch if expanded. Fig. 58 shows both sexes of this insect. Like other clear-winged moths, the insect flies about during the hottest part of the day in early summer, and the females are also engaged at this time in depositing their eggs. The young larva enters the cane, inside of which it feeds upon the pith; it gradually works its way down to the root,

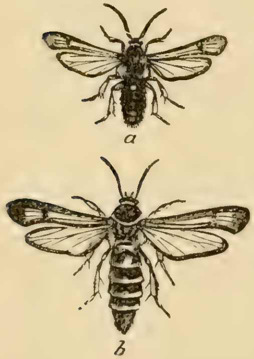


Fig. 58.—*Bembecina marginata* Harr.—*a*, male; *b*, female.

in which it passes the winter; here it eats extensive cavities. As soon as the warmer weather indicates the advent of spring the worm becomes active again and enters another cane, where it feeds for some time. When full grown the worm prepares an opening for exit, as the moth has no mouth to do so and would otherwise die a prisoner. At this time the larva measures about an inch and is of a yellowish-white color with a dark brown head and a few shining dots on each segment of the body. Near the place of exit the larva changes to a pupa and when the time arrives for the moth to escape the pupa wriggles itself forward by means of fine spines encircling the segments. Soon after the moth appears, leaving the empty shell of the pupa sticking out of the cane.

The canes infested by such worms invariably die. But little can be done to prevent the damage to our raspberry canes as the worms are so well hidden, and the only method we have to lessen the evil is to remove all old canes and all others that are not in a thrifty condition.

THE GRAPE-VINE ROOT-BORER.

(*Sciapteron polistiformis* Harr.).

This fine insect is much larger than the one just described, measuring with expanded wings fully an inch and a half across. It is very uncommon in Minnesota, and but a single specimen was seen in 1898 flying about the wild grape-vines on Gray Cloud Island. The moth resembles one of our large paper-wasps (*Polistes*), and on that account was named "Polistes-shaped." The sexes vary, the male having toothed antennæ, while those of the female are simple. The male has thorax and abdomen darker in color, and has also in addition to the short pencils of orange hairs on the lower side of the abdomen two longer ones above. There is a bright yellow band on the base of the second abdominal segment and usually another one on the fourth, but this is sometimes wanting. The fore-wings are brownish-black, with a more or less distinct clear patch at the base; the hind-wings are transparent, with the veins, terminal border, and fringe, brownish-black.

The insect is much more common in the Southern States, where it is sometimes very destructive to the wild and cultivated grapes. It is said that the female moth deposits her eggs upon the collar of the vine, close to the earth. As soon as hatched the worm enters the cane and descends to the roots, where it consumes the bark and sap-wood, eating irregular furrows in their substance; sometimes it eats the bark, and at other times works its way into the roots. The mature larva is of a yellowish-white color, with darker head and legs, and measures about an inch and a half in length. It now forms a pod-like cocoon of a gummy sort of silk, covered with little bits of wood, bark and earth, and situated within or adjacent to the injured root. In this cocoon the larva changes to a brown pupa which works itself out of it by means of minute teeth upon the margins of the segments, as soon as the moth within is ready to emerge. Fig. 59 shows the different states of this insect.

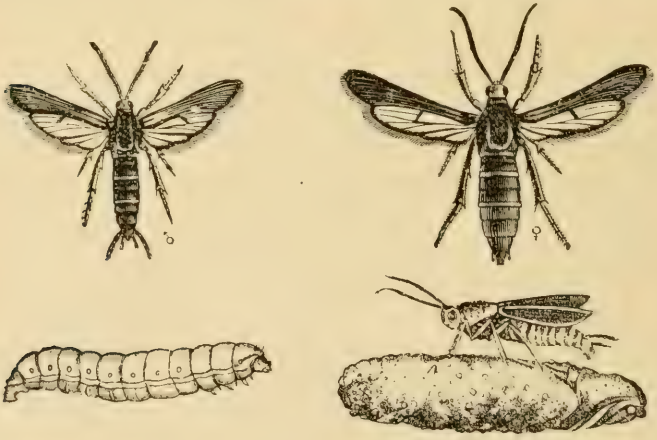


Fig. 59.—*Sciapteron polistiformis* Harr., larva, cocoon, male and female.

In several instances the roots of very small plum trees growing in a nursery were destroyed by a similar larva which had to live outside of these roots as these were quite small. Considerable damage was caused by the worms, but as none could be kept alive in confinement it is impossible to state to what species these destructive larvæ belonged. Infested roots are shown in Fig. 60, Plate IX.

THE PEACH-TREE BORER.

(*Sannina exitiosa* Say).

This is a notorious pest and very destructive to peach orchards. It is a pity that it is not found in our State, as its presence would indicate that we possessed a clime warm enough to successfully grow the succulent peach. Still some peach trees are grown and succeed in Minnesota, and with proper protection it is by no means impossible to grow this fruit. Perhaps the insect mentioned above as being injurious to the roots of plum-trees is this very species, as the peach-tree borer works also upon the plum. In fact, as this insect is a native one, it had in former times to feed upon something else than the peach-tree, as this comes from Persia.

The adult insects appear in the Northern States and Canada from about the middle of July to the end of August. The sexes differ very much. The female is much larger than the male, with a broad and heavy abdomen; her body is of a glossy, steel-blue color with a purplish reflection, and a broad band of orange-yellow crosses the abdomen. The fore-wings are opaque and similar to the color of the body; their tips and fringes have a purplish tint, both above and beneath. The hind-wings are transparent and broadly margined with steel-blue. The wings expand about an inch and a half across. The smaller male, measuring not more than an inch, has also a steel-blue body with golden-yellow markings and a glossy, silken lustre. Its body is quite slender; the black antennæ are fringed on their inner side with numerous fine, short hairs, which are absent in the female. Head and thorax are marked with yellow, and the abdomen has two slender yellow bands above and a white line on each side of the tuft of hairs at its tip. The wings are transparent; the veins, margins and fringe, steel-blue, and a steel-blue band extends nearly across them beyond the middle. The feet and legs are marked with white. Both sexes are illustrated in Fig. 61.

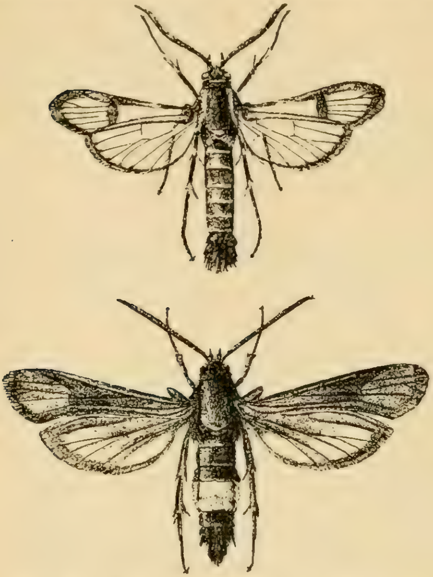


Fig. 61.—*Sannina exitiosa* Say. Male and female.

The female deposits her eggs on the bark of the tree at the surface of the ground. The yellowish eggs, with finely sculptured surfaces, are oval and slightly flattened, and are glued to the surface of the bark by a gummy secretion.

Prof. Saunders, in his excellent book: "Insects injurious to fruit;" gives a number of remedies against this pest, and as we can learn some lessons from them, they are quoted:

"Remedies.—Several remedies have been proposed to meet this evil. Where the larvæ are present, they are readily detected in consequence of the exudation of gum; hence early in spring the trees should be carefully examined, a little of the earth removed from about the base, and, if masses of gum are found, the larvæ searched for and destroyed. Hot water is said to be very effectual in killing them; it should be used very hot, and after the earth has been removed, so as to insure its reaching the culprits before it cools. Among the preventive measures, much has been written in favor of mounding the trees, banking the earth up around the trunk to the height of a foot or more, and pressing it firmly about the tree. Some allow the mounds to remain permanently; but the better plan seems to be to mound up late in the spring or toward midsummer, and level off the ground again in September, after egg-laying has ceased and the moths have disappeared. This treatment is said to make the bark very tender and liable to injury during the winter, and it is recommended by some to defer its application until the fourth year, by which time the bark will have become sufficiently thickened and hardy to endure the treatment without injury. Placing around the roots a bed of cinders, ashes, or lime, plastering the base of the trunk with mortar or clay and covering it with stout paper, coating the tree with an application of soap or tobacco water, have all had their advocates; but the weight of testimony is in favor of the removal of the larvæ with the knife late in the autumn or early in the spring, and subsequently mounding the trees in the manner already described.

"Another remedy proposed is to cover the trunk with straw in the following manner: Scrape the earth away from the collar, place a handful of straight straw erect around the trunk, fastening it with twine, then return the soil, which will keep the ends of the straw in their place. The straw should entirely cover the bark, and the twine be loosened as the trunk increases in size. Trees so protected are said to have remained uninjured while all around them have suffered from the borer."

THE CURRANT BORER.

(*Sesia tipuliformis* Linn.).

This insect was described and illustrated in the first annual report of the entomologist, but to have all the descriptions of lepidopterous insects injurious to our fruit trees together in one volume, it is repeated.

The currants in all their varieties, as well as the different kinds of gooseberries, have no greater enemy than the above borer. The damage it causes is so much greater than that inflicted by other enemies of these plants, because a whole cane, even a whole plant, may be killed by a single borer, nor can its work be noticed until the injury has been done. Like so many of our destructive insects it was introduced from Europe with the plants that it destroys, but it is now more injurious here than in its original home. The insect is illustrated in Fig. 62, Plate IX, where its work, the larva, empty pupa and adult are shown. A glance at the latter shows that it is a beautiful moth. When seen in June upon the bright foliage of currants, it is indeed an elegant insect, in whatever position it may be observed. It shows to the greatest advantage, however, when making love to its mate. In this case the male dances about very gracefully, rapidly opening the fan-like feathers at the end of the abdomen; and as the whole insect is clothed in glossy scales it reflects all the prismatic colors. The adult insect, as seen in the illustration, is quite different from ordinary moths, having its wings but partly covered with scales, the uncolored parts being glassy, hence the reason why such moths are frequently called "glassy wings." Such moths resemble flies and wasps, and are frequently mistaken for such; in fact they sometimes mimic such stinging insects so effectually that even a well trained entomologist has some scruples about capturing them with his hand. Some of these moths carry this resemblance so far as to even threaten to sting, though not possessing an organ to execute the threat. This currant-borer does not possess a tapering body and its posterior end is ornamented with a fan-like covering of scales. The wings have black markings with purplish reflections; the body is ringed with yellow, the thorax is also ornamented with yellow lines. The female, though resembling the male very closely, is not so active; she has other and more serious business on hand than dancing, since she has to deposit her numerous and rapidly developing eggs. For this purpose she selects canes at least one year old. The beautiful egg, possessing the usual form of eggs of lepidopterous borers, is fastened most frequently in the angle made by the leaf and the cane. Other eggs are laid below the loose scales found upon the canes and in the cracks of bark. These eggs soon hatch, and the young caterpillar or borer eats its way into the interior of the cane, penetrating to its very pith. Here, apparently well protected against all enemies, the caterpillar has a congenial home surrounded with plenty of food, and soon a long tunnel, sometimes several feet in length, shows that the appetite of this recluse does not suffer by its isolation. We never find more than one caterpillar in each burrow, showing that the females have been very careful in exploring the cane before entrusting it with an egg. The caterpillars grow but slowly, and at the approach of winter are not much more than half grown. They now prepare for the cold season by retiring as deeply in their tunnels as these will permit, and surrounded by frass and chewed up fibres of the pith and wood, they are well protected.

The larva possesses the usual form of caterpillars of this family of moths. It is of a yellowish color, with a brown head, as shown in the illustration which also shows the piliferous spots and hairs.

When the warmth of the sun in spring starts vegetation, and soon after the flowers of the currants open, the hibernating larva also feels imbued with new life and energy, and rapidly grows to its full size, being after the long enforced fast much more voracious than during the previous season. This great appetite is soon felt by the plants; many canes with flowers and partly expanded foliage show by their small leaves and their yellowish appearance that they are suffering from the insidious enemy in their interior. Most of the canes attacked soon die, or are broken down by the first wind or heavy rain. The larger ones may remain alive for another year; but are certain to die later, as a hole through which the winged borer has issued permits the entrance of rain and this moisture, in combination with parasitic or other fungi, soon starts decay, as may be seen by the black interior of such tunnels.

The larva, when full grown, prepares for pupation by first eating a hole through the cane so as to permit the future moth to escape. If this were not done the moth, which has no mouth, or at least only a rudimentary one and which is consequently unable to eat its way out of the cane, could not leave at all. After providing for such an exit, this hole is slightly closed from within with bits of wood, and the larva changes to a chrysalis or pupa, as is shown in the illustration.

The pupa is of a light brown color. In the illustration an empty one is shown projecting from the hole or exit prepared by the caterpillar. The peculiar spines enabling it to move are also shown. The two long processes seen in the illustration are simply the sheaths in which the long antennæ were hidden; before the moth issued, these were soldered to the sides of the pupa and were not more prominent than the encased wings and legs.

Towards the end of May or during June, according to the climatic conditions prevailing at the time, the pupa forces its way partly out of the tunnel of the cane and pushes away the plug closing the exit. This movement is made possible by the rows of spines found upon the abdominal segments. The pupa is now partly outside of the cane and is held in position by its posterior portion. It now splits open in the usual manner upon its back and the winged moth appears.

To this account of the life-history of this injurious borer may be added that no parasites have as yet been discovered in Minnesota. Yet several times a silken cocoon was found in a tunnel which, apparently, had been recently inhabited by a borer. The small wasp issuing from this cocoon is distinguished by blackish wings, black body, and bright red abdomen; it is a species of *Bracon*. In some cases mites were found upon the dead caterpillars inside the burrow, but whether these had killed the caterpillar, or had simply come to feast upon its dead body, is impossible to say, though most likely the former was the case.

Remedies.—An insect so well hidden as this borer can not be reached by any poison; and our only hope is to prevent it from entering at all. This seems to be very feasible, as the egg is deposited upon the cane or pushed beneath loose bark, which is frequently the case with borers belonging to the order of beetles. When the young currant-borer leaves the egg it has to come in contact with the bark through which it has to eat its way. If, therefore, the bark could be poisoned, we should have a sure remedy; but when it comes to a practical application of this spraying, it will be found that currant bushes are rather difficult to spray so thoroughly as to coat the canes in a uniform manner with the poison. The writer has tried repeatedly to coat the canes with arsenical poisons before the foliage had appeared. There was no difficulty in doing so, but it was found later that the plants sprayed in this manner contained just as many borers as those not sprayed. This is owing to the fact that at the period when this spraying can be done, we usually have the most frequent rains. There is, however, another remedy which is easily applied and which, if carefully carried out, will eradicate this insect from our gardens. Canes that harbor the borer can always be detected and if found should be pruned below the lowest part of the tunnel. The canes that have been cut off should be taken away from the garden and burned as soon as dry, or if such pruning is done late in the spring the canes should be covered up with soil, so as to prevent the moths from leaving. In no case should they be left on the ground, because cutting them off from the plant does not kill the borer. The pruning is also otherwise of benefit to the currants which are usually permitted to grow too much wood and become too old for the benefit of good crops of berries.

Some varieties of currants and gooseberries are stated to be free from borers. If such is the case the writer has not seen them. It has also been claimed that black currants are not to the taste of such borers, but those under observation not only did not escape the ravages of this pest, but were even preferred to the red and white currants that grew in their immediate vicinity.

ROOT AND STEM BORER OF BLACKBERRY AND RASPBERRY.

(*Sesia hemizonæ* H. Edw.).

It is doubtful whether this insect occurs in Minnesota, although a broken specimen of it was received from a nursery. The larva is a pale worm with darker head and legs, and feeds in the roots or base of the canes of the cultivated blackberry and raspberry, invariably killing the canes infested, or the entire plant. The worms feed only on the pith, and thus cause a wilting of the cane. The canes infested should be cut out and burned. The moth possesses golden-brown fore-wings, and as all the borders are wide, only a small transparent space is left; the discal mark is purple-black, orange behind, with golden reflections; hind-wings with golden margins; fringes of both wings golden-brown; head black, with a few shining blue scales in front; thorax with collar, tegulæ and base lemon-yellow; abdomen ringed with lemon-yellow; caudal tuft deep lemon-yellow, with a black centre; palpi, fore-coxæ and tibiæ lemon-yellow, the latter banded with brown.

Neglected plants, or plants infested with other insects or diseases, are more apt to harbor this and allied borers than plants which receive the proper attention.

THE PLUM TREE BORER.

(*Sesia pictipes* G. & R.).

This insect is by no means uncommon, and seems to be increasing in numbers as our plum trees grow older and become more numerous. The sexes of *pictipes* are similar and so closely resemble the male *exitiosa* that one may be readily mistaken for the other. The male is shown in Fig. 63.

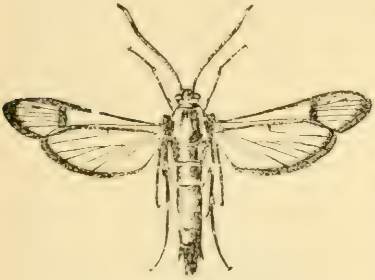


Fig. 63.—*Sesia pictipes* G. & R. Male.

The larva of this borer feeds mainly in the trunks and branches of both cultivated and wild plums and in wild black and red cherries. The pruning knife is the best remedy we have against this insect.

FAMILY AGARISTIDÆ OR WOOD-NYMPH MOTHS.

The moths belonging to this family are mostly beautiful insects, being either black, with large, white, yellow or red spots and patches upon their wings, or they have their front-wings white, margined with brown, and the hind-wings pale yellow. But few species are found, which fly chiefly during the day, but some of them are also attracted to the electric light.

We have in Minnesota a number of such moths, which are decidedly destructive in their early stages to our grape-vines, much more so than most other kinds of insects. In some years nearly the entire foliage of cultivated and wild grapes and of the Virginia creepers is devoured by them in the course of a few days.

THE EIGHT-SPOTTED FORESTER.

(*Alypia octomaculata* Hbn.).

This is a most beautiful moth, which flies about in the bright sunlight, displaying its brilliant colors upon the leaves of grape-vines which contrast strongly with the black, white, red and yellow colors of the moth. It never hides, but always displays its colors. This is evidently done as a protection, as these colors are warning colors, which tell birds and other lovers of insects as food that the moth showing them is not good to eat. The ground-color of this fine moth is a deep blue-black; two large pale-yellow spots are found on each of the front-wings, and two white spots on each of the hind-wings, the one nearer the base being much the largest. The shoulder-covers are yellow, and the legs partly orange. The sexes differ somewhat, the male having proportionately larger and more conspicuous spots, and possesses also a white mark along the tip of the abdomen. The wings, when expanded, measure from an inch to an inch and a half across.

The caterpillar is of a light brownish color, with many black lines and an orange band across each segment. It is distinguished from other similar larvæ by having eight black and white lines on each segment. The caterpillars have a peculiar bluish appearance which is owing to the blending of the two colors. The head and the shield on the first segment are a shiny, bright, deep-orange color, marked with black dots; there is a prominent transverse orange-red band, faint on segments two and three, conspicuous on four and eleven, and uniform in the middle of each of the other segments. In the middle segments of the body each orange band contains eight black conical elevated tubercles, from each of which grows a white hair. A lateral white wavy band, obsolete on the thoracic segments, but very conspicuous on the tenth and eleventh, is a very characteristic feature of this caterpillar. The very young worms are whitish, with brown transverse lines; they feed beneath the leaves, and can let themselves down by a silken thread; the full grown larvæ also often conceal themselves within a folded leaf. The larva becomes nearly an inch and a half in length; when full grown it bores into any soft, rotten, or even almost sound wood, and if such material should be lacking it transforms to a pupa within a very slight cocoon formed without silk upon or just below the surface of the earth. With us this species is single brooded and passes the winter in the pupal stage.

This insect occurs frequently in such numbers upon the beautiful Virginia creepers adorning verandas that not a leaf is left, and the plant becomes just the opposite from what it was intended to be. This happens frequently in our larger cities, and of course should not be the case. As the caterpillars feed more or less exposed they can easily be seen and destroyed by the use of Paris-green or London-purple. If people object to the use of these poisons they should use a spray composed of two ounces of pyrethrum to a gallon of water. If used as long as the caterpillars are still young all injuries to the ornamental plants and the grape-vines can be prevented.

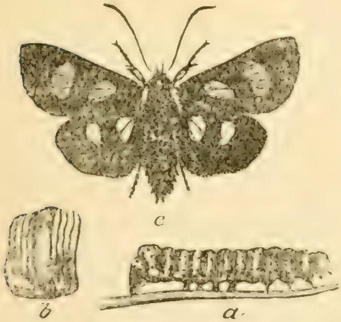


Fig. 66.—*Alypia octomaculata* Hbn.: *a*, caterpillar; *b*, one segment of the same *c*, adult. After Riley.

This beautiful moth is illustrated in Figs. 64, 65 and 70 on Plates X and XI, and also in Fig. 66.

THE GRAPE-VINE EPIMENIS.

(*Psychomorpha epimenis* Drury).

There is another bluish caterpillar found feeding upon the foliage of the grape-vine, but it is very uncommon in our State. It is much smaller than the one described above. It transforms into a most strikingly marked moth, of a deep, velvety-black color, with a broad irregularly lunate white patch across the outer third of the front wings, and a somewhat larger more regular patch of orange-red or brick-red on the hind-wings. The under side is similarly marked, but that of the front-wings is less velvety, with two additional white spots inside near the costa, the outer one generally, and sometimes both of them, connected with a broad white patch. The surface of the wings is sprinkled with brilliant purple scales, which form a narrow band near the outer margin of each, and appear more or less distinctly on the basal half of the front-wings. The antennæ of the female are thread-like, with alternate black and white scales; those of the male are broadly toothed on two sides. The moth is shown in Fig. 67; also in Fig. 70, Plate X.

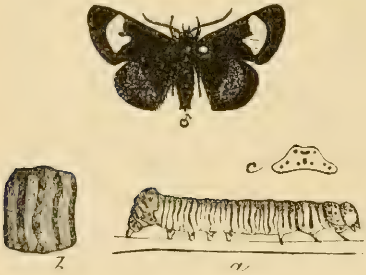


Fig. 67.—*Psychomorpha epimenis* Drury; *a*, larva; *b*, one segment of the same; and male moth. After Riley.

The young larva attacks the terminal buds of the vine in spring, and by fastening the young leaves together by a few silken threads it forms a little enclosure. Early in June, when it is full grown, it bores into soft wood or any other suitable material, and there changes to a reddish-brown pupa, about four-tenths of an inch long, roughened on the joints, and having a curious flattened horny projection on each side of the tip. The insect winters over in the pupal state.

THE BEAUTIFUL WOOD-NYMPH.

(*Eudryas grata* Fab.).

The larva of this beautiful moth is almost as destructive to the foliage of the grape as the Eight-spotted Forester, but it is not found in such destructive numbers year after year as the latter insect. The moth has milk-white front-wings, broadly bordered and marked with brownish-purple. The band on the outer margin is shaded on the inner side with olive-green and marked towards the edge with a slender, wavy white line. The brownish-purple band is continued along the hinder edges, but gradually becomes narrower, and terminates near the base. There are two brownish spots near the middle of the front-wing, one round, the other kidney-shaped; they are frequently so densely covered with white scales as to be indistinct above, but they are always visible on the under surface. The under surface of the wings is reddish-yellow. The head is black, and there is a wide black stripe down the back, merging into a series of black spots extending to near the tip of the abdomen, which is tufted with white. The shoulder-covers are white, and the sides of the body deep yellow, with a row of black dots along each side close to the under surface.

The moth, which is active at night, and sometimes attracted to the electric lights in large numbers, is often discovered during the day upon the surface of the leaves of its food-plants. (See Fig. 65, Plate X). Its closed wings form a steep roof over its back, and its forelegs, which have a curious muff-like tuft of white hairs, are protruded and give the insect a very peculiar appearance. Looking at it from a short distance the insect resembles very closely the fresh and still semi-fluid droppings of a bird. The moth evidently depends upon this resemblance, which is sometimes unpleasantly realistic, as a protection against birds.

There are hardly two moths more unlike in general appearance than the beautiful Wood-nymph and the Eight-spotted Forester, and yet their caterpillars bear such a close resemblance to each other that they are not readily distinguished from each other, especially as they frequently feed side by side upon the same grapevine. Generally however, the caterpillar of *grata* appears a little later in the season. It is shown in Fig. 68, Plate XII.

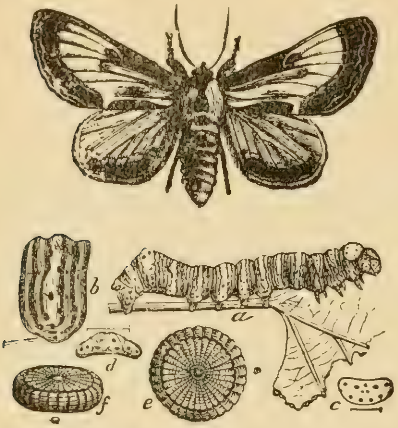


Fig. 68.—*Eudryas grata* Fab ; *a*, larva; *b*, one segment of same; *e* and *f*, eggs, greatly enlarged; anp adult. After Riley.

The eggs are deposited upon the under side of the leaf, singly or in groups. The full grown caterpillars measure about an inch and a half in length; their bodies taper towards the head, becoming thicker near the posterior end. The head of the caterpillar is dull orange, with black dots; the body is pale bluish, crossed by orange and black lines which are arranged as shown in the illustration, Fig. 69. Each segment, with the exception of the head and the last one, is crossed by a brick or orange-colored band of uniform width, excepting the one on the twelfth segment, which is broader; on the last segment we find two such bands. All these bands contain black dots, from which a simple short brown hair arises. Each segment is crossed by six black lines; the breathing-pores are oval and black. Besides the grape-vine the caterpillars feed also upon the Virginia creeper, and occasionally upon the hop. They are most numerous late in summer, and do not web together leaves for shelter, but hide on their under side. When at rest, the caterpillar depresses the head and raises the anterior part of the body, and in this manner assumes the position of a Sphinx caterpillar.

When mature the caterpillar descends to the ground, and transforms to a dark-brown and rough pupa, about seven-tenths of an inch long, with an obtusely conical tip of the abdomen, ending in four tubercles. In captivity it readily enters pieces of soft wood, or of cork, in which it forms a cell for the purpose of pupation; by uniting with a sticky secretion bits of wood and cork it forms a cap or lid over the cell.

Like the Eight-spotted Forester this insect is kept in check by parasites, but chiefly by Tachina flies, which deposit their cream-white eggs upon the back of the caterpillar, usually close behind its head.

THE PEARL WOOD-NYMPH.

(*Eudryas unio* Hub.).

The moth (Fig. 69 and 70, Plate X) of this equally pretty insect is a little smaller than *grata*, measuring with expanded wings about one inch and three-eighths; it differs but slightly from its larger relative. The brownish-purple stripe on the front margin extends farther along the wing; the bordering of the outer margin is paler and more uniform in width; the inner edge is wavy instead of straight, and the bordering of the hind margin is wider and more distinct.

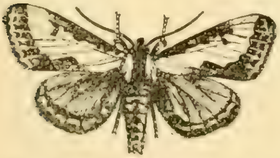


Fig 69.—*Eudryas unio* Hub.; Adult. After Riley.

The larva is nearly an inch and a quarter long. It has an orange-colored head, spotted with black; its body is banded with orange, white and black, most segments having three white and three black lines on each side of the central orange band. The pupa is reddish-brown, roughened on the back with very minute teeth; a thick and blunt spine occurs on each side of the tip of the abdomen.

This insect is not seen very often on our grape-vines, but as this moth has been frequently seen near the electric light it must be rather common. The caterpillars are not so particular about their food as the other closely allied species and they have also been found feeding upon such plants as *Epilobium* and *Hibiscus*.

The four species of Wood-Nymphs are also shown in Fig. 70, Plate X.

FAMILY PYROMORPHIDÆ OR SMOKY MOTHS.

But few moths belonging to this family are found in the United States. The moths are small, chiefly of a smoky-black color, although some are marked with brighter colors.

THE AMERICAN PROCRIS.

(*Harrisima americana* Harr.).

The writer has never found in Minnesota the caterpillars of this insect, which is quite destructive to the foliage of the grape-vine in other states, but as he has repeatedly captured the moths there is no doubt that the insect is an inhabitant of our state.

The eggs, twenty or more of which were deposited together, are fastened to the under side of the leaves.

The caterpillars of the Procris do not scatter after leaving the eggs, as all the insects described before, but lead a social life, feeding side by side on the under side of a leaf, their heads all directed towards the margin of the same. These little worms, in black and yellow uniforms, eat at first only the soft tissues of the foliage, leaving the fine net-work of veins untouched; but as they grow older and stronger all but the large veins are eaten. The caterpillars reach their full size in August, and measure now about six-tenths of an inch. They are at that age of a yellow color, slightly hairy, with a transverse row of rather large spots on each segment. As soon as the caterpillars are mature they disperse, each one searching for and retiring to some sheltered spot, in which they construct a tough and oblong-oval cocoon, inside of which they change in the course of three or four days to a shining brown pupa, about three-tenths of an inch long. Further south two or even three generations are produced during a year, but whether the insect is single or double brooded in Minnesota is not known.

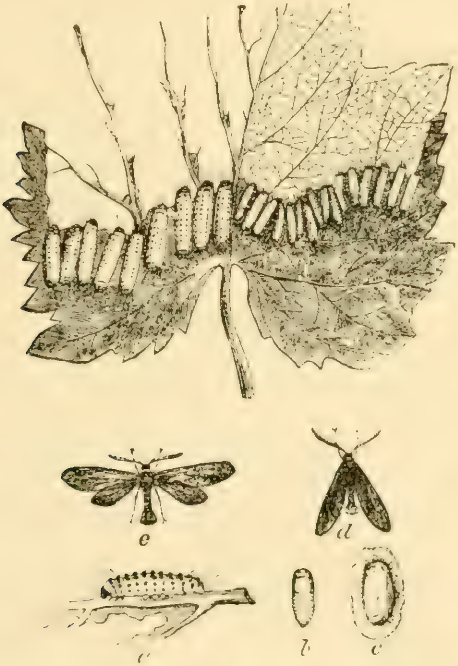


Fig. 71 —*Harrisima americana* Harr.; *a*, caterpillar; *b*, pupa; *c*, cocoon; *d* and *e*, moths; above, a colony of caterpillars. After Riley.

The little moth is of a bluish or greenish-black color; it is ornamented with a deep orange-colored collar, and a notched tuft at the end of the long body. The moth has very narrow wings, which expand nearly an inch across, and flies during the warmest hours of the day, when it frequents flowers. Its flight is rather peculiar, and is quite slow and unsteady. Wherever this insect occurs in large numbers it becomes quite injurious, but as it leads a social life in its caterpillar state it can readily be destroyed by the use of arsenical poisons. Fig. 71 shows the different states of this insect; the moth is also shown in Fig. 72, Plate IX.

FAMILY ZYGÆNIDÆ OR ZYGÆNIDS.

But few species of these moths occur in the United States, and none are destructive to fruit trees. They are distinguished from the allied families by the structure of the hind-wings, which are in some cases greatly reduced in size, as shown in the illustration of the *Scepsis fulvicollis* Hbn. (Fig. 72, Plate IX), a black moth with fulvous color, frequently seen on the flowers of the golden-rods. A larger species, the *Ctenucha virginica* Charp. is shown on the same Plate in Fig. 72.

FAMILY LITHOSIIDÆ OR FOOTMAN MOTHS.

This family includes small moths with rather slender bodies, filiform antennæ, and usually narrow fore-wings and broad hind-wings. They are closely allied to the next family. Usually they are of sombre colors, though some are rather highly colored. Their larvæ are cylindrical, covered with short and stiff hairs, and most of them feed upon lichens. None are destructive, but to give an idea of their general appearance one of the most common species, the Striped Footman (*Hypoprepia fucosa* Hbn.) is shown in Fig. 72 on Plate IX. It is of a deep scarlet color, with three broad and lead-colored stripes on the fore-wings not shown in the photograph.

FAMILY ARCTIIDÆ OR WOOLY BEARS.

The Arctiids, also called Wooly Bears and Tiger-moths, are stout-bodied moths, with moderately broad wings, which are usually spotted or striped. Some of them are very gaily colored, others are pure white. When at rest they usually fold their wings roof-like upon the body. Most of them are nocturnal and are attracted to lights. Their larvæ are mostly clothed with dense clusters of hairs, and are usually very general feeders, preferring herbaceous plants, though some are destructive to the foliage of trees.

THE BLUE-SPANGLED CATERPILLARS.

(*Callimorpha Lecontei Boisd.* and *fulvicosta* Clem.).

There are some slender bodied Arctiids that possess fine or bristle-like antennæ, which are not distinctly feathered in either sex; their tongues are also quite long. They belong to the genus *Callimorpha* (meaning beautiful form). In the Eastern and Southern States these caterpillars occur more commonly upon the peach; here in Minnesota they have been found upon the apple, but chiefly upon the blackberries. They are black worms, covered with short stiff hairs, and studded with peculiar blue spots, which have given them the above name. They spend the winter in some sheltered spots, as under loose bark, etc., but as soon as the leaves expand in spring, they forsake these shelters and commence to feed. As they grow rapidly they soon reach their full size, and now measure about one inch in length. They are of a velvety-black color above, and pale bluish, speckled with black, below. A deep orange line extends along the back, and a still more distinct wavy or broken one along each side. The body is covered with many steel-blue warts, with a polished and quite brilliant surface; from each issues a short and bristly hair. As soon as full grown the caterpillar selects a sheltered spot, and here spins a slight and white silken cocoon. The pupa is purplish-brown, finely punctated, and terminates in a flat plate tipped with yellowish-brown and curled bristles.

The moth flies during the day in June. It is by no means very uncommon, and delights to fly about the edges of forests, or wherever the ground is overgrown with blackberries and similar plants. We have at least two species of this interesting moth; the *Lecontei var militaris* Harr., having the fore-wings ornamented with broad black markings, and the *fulvicosta* Clem., where the cream-colored fore-wings possess a fulvous border. Yellow markings are also found on the head, collar, and base and tip of the abdomen. Fig. 73 shows the larva and adult; Fig. 74, Plate XII, shows the same insect and also two forms of *C. contigua* Walk.

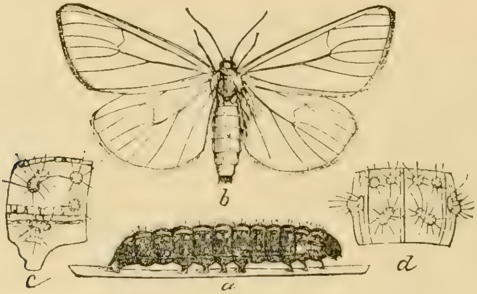


Fig. 73.—*Callimorpha fulvicosta* Clem.; *a*, caterpillar; *b*, moth; *c* and *d*, segments of body of larva. After Riley.

These caterpillars have been known to cause considerable damage to the young foliage of the peach tree and to the young leaves of the blackberries. They are easily shaken into sheets, and even into inverted umbrellas, because they drop to the ground as soon as the plants upon which they are feeding are jarred. In extreme cases the arsenical poisons should be used.

A number of other Arctiids or "Wooly Bears" are injurious to cultivated fruit trees and our smaller fruits. Generally, however, their caterpillars consume all kinds of low-growing plants and only exceptionally prove destructive to taller shrubs and trees.

THE ISABELLA TIGER-MOTH.

(*Pyrrharctia isabella* S. & A.).

This is the well-known caterpillar frequently called the "Hedge-Hog," from the habit of rolling itself into a ball when alarmed (Fig. 75). It has a thick coat of fur, composed of stiff hairs, which point in all directions. The hairs are black on each end of the body of the caterpillar, but reddish on the middle. As all the hairs are pretty evenly and closely shorn they give the caterpillar a velvety appearance, and as they are also very elastic, it is not easy to pick up the curled larva, which generally manages to slip away. Its favorite food is plantain, clover, dandelions, grasses and many other plants. It winters over in some sheltered spot, rolled up like a hedge-hog. In most cases it finds shelter below loose bark, under pieces of bark resting on the ground, and is found in large numbers under wooden sidewalks. It is difficult to understand that an insect thus slightly protected should be able to withstand some of our very cold winters, and that the fluids found in its body are not frozen solid. Early in the spring the caterpillar makes up for the long

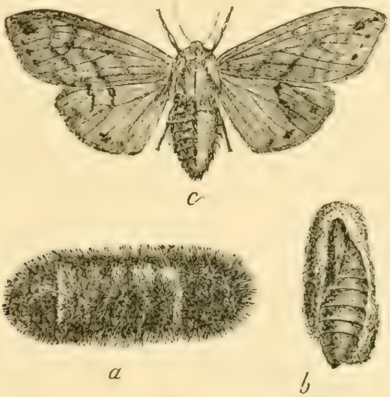


Fig. 75.—*Pyrrharctia isabella* S. & A.; *a*, caterpillar; *b*, pupa in cocoon; *c*, moth. After Riley.

enforced rest, and feeding upon the first green vegetation, finally spins a cocoon, which is principally composed of the barbed hairs of the caterpillar itself, interwoven with coarse silk. The pupa is brown, with tufts of golden bristles, and with a tuft at the extremity. Prof. Comstock makes the following interesting remarks about this insect in his "Manual for the Study of Insects": 'Hurrying along like a caterpillar in the fall' is a common saying among country people in New England, and probably had its origin in observations made upon the larva of the Isabella Tiger-moth. This is the evenly clipped, furry caterpillar, reddish-brown in the middle and black at either end, which is seen so commonly in the autumn or early spring. Its evident haste to get somewhere, in the autumn, is almost painful to witness. A nervous anxiety is apparent in every undulating movement of its body; and frequently its shining black head is raised high in the air, and moved from side to side, while it gets its bearings. Occasionally after such an observation it evidently finds it is mistaken, and turns sharply and hastens along faster than ever in another direction."

The moth, which is also shown in Fig. 76, Plate XI, is of a dull orange color, with the front-wings variegated with dusky, and spotted with black. The hind-wings are lighter colored, and also marked with black spots; they vary somewhat in the sexes. The body has also the same general color of the wings; on the middle of the back of the abdomen is a row of about six black dots, and on each side of the body occurs a similar row of dots.

This caterpillar becomes sometimes destructive to the cuttings of apple-trees, etc., in our nurseries; blackberry and raspberry canes are also sometimes destroyed, as the larvæ eat the tips of the young shoots. They are readily poisoned and thus kept in check.

These "Hedge-Hog" caterpillars, although always common, are sometimes exceedingly so, while at other times but few can be found. Their absence in the usual numbers is caused by the fact that very many of them are killed by a disease. Caterpillars attacked by the *Muscardine* are stiffly fastened to their food-plants, and are covered with a white efflorescence; this latter is not very apparent at the base of the dense hairs, hence such diseased or dead caterpillars look for a long time quite life-like.

THE LARGE YELLOW BEAR.

(*Leucarctia acræa* Drury).

These large and wooly caterpillars are sometimes quite numerous in our gardens and orchards. Usually they feed upon grasses and other low growing plants, but they are not slow to eat also the leaves of young fruit trees and of the small fruit. Both sexes of the moth are shown in Fig. 77, Plate XI.

THE COMMON YELLOW BEAR.

(*Spilosoma virginica* Fab.).

This is one of our most common hairy caterpillars, and whoever has a garden must have met with this troublesome insect, which devours alike flowers, vegetables and fruit. With us it seems to be very partial to the leaves of the grapevine, apple, currant and gooseberry, though nearly all other plants are eaten when pressed by hunger, and the insect is sometimes very destructive to corn, beans and peas. It is found from June to late in September. When young the caterpillars are bluish-white, but when full grown they may be found of a pale cream color, yellow, light-brown or very dark-brown, the different colors often appearing in a brood hatched from one batch of eggs. Yellow is, however, the most common color, and in all the different color-varieties the under side is dark, with a longitudinal black line, more or less interrupted, along each side of the body, and a transverse line of the same color between each of the joints. Head and feet are ochre-yellow; the hairs spring from dark yellow warts, of which there are ten on each joint; those on joint one being scarcely visible, and those on joint twelve coalescing. We have two annual broods in Minnesota, the last passing the winter in the pupal state. The pupa is protected by a slight cocoon, made almost entirely of the caterpillar's hair; these are chiefly held or felted together by the interlocking of their minute barbs, and the whole is strengthened by a few silken threads.

The bright-colored eggs, which are round and yellow, are deposited on the under side of leaves in large clusters, and hatch into small hairy caterpillars, which feed together for a short time, but gradually scatter. As long as young they devour only the under side of the leaf, but the corresponding upper surface of it soon turns yellow and withers.

The moth, which is very generally called "The Miller," frequently flies into our rooms at night. It is easily recognized by its pure white color, by having the abdomen orange-colored above, with three rows of black spots; the wings possess also a few black dots, varying in number, there being usually two on each side of the fore and three on each of the hind-wings, though sometimes all the wings are almost immaculate, except one spot on the disk of the fore-wings. The antennæ are white above, dark brown below; head and thorax are white.

The best time to destroy these troublesome caterpillars is soon after they hatch, and when they are still feeding side by side. By making the worms drop into a vessel containing some kerosene oil, we can kill them quickly, and as they curl up and drop when touched even very lightly the work is rapidly performed. Of course if they are very numerous we have to use one of the arsenical poisons.

It is very fortunate that this species is subject to the attack of a number of parasites, which kill immense numbers of them. Without the assistance of these beneficial insects the caterpillars would multiply to such a degree as to be soon beyond our control. This species is illustrated in Fig. 78.

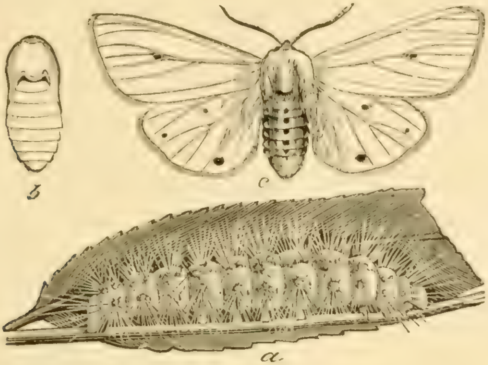


Fig. 78.—*Spilosoma virginica* Fab.: *a*, caterpillar; *b*, pupa; *c*, adult. After Riley.

THE FALL WEB-WORM.

(*Hyphantria cunea* Drury).

This is getting to be a very destructive insect in Minnesota, which at present seems to be confined to plum-trees. Both the wild and cultivated varieties are infested, and toward the middle of August they are disfigured by large nests made by colonies of these caterpillars. When we investigate these bulky nests, which show no regularity of construction like those of the tent-caterpillars, we find them composed of numerous smaller nests, of which the older ones are more or less filled with excrement, old skins, and the white head-plates of the caterpillars. Sometimes we find in them also the egg-shaped cocoons of hymenopterous parasites. The caterpillars are not as social in their habits as those of the tent caterpillars, and they do not come and go to their nest in regular armies, but rather protect themselves when feeding by simply building a shelter over their food. Fig. 79, on Plate XXII, shows one of these nests.

The moths of this species of insects vary greatly, both in size and markings, and they have in consequence of such variation received many scientific names, such as *cunea*, *textor*, *punctata* and *punctatissima*, but there is no doubt that all these names belong to one species, as has been proven by the frequent breeding of these insects in confinement. The moth is of a milk-white color, and in Minnesota without spots. The antennæ are gray; those of the male doubly feathered below, those of the females with two rows of minute teeth only. The front thighs are tawny-yellow; the feet blackish-brown. When the wings are expanded they measure about one and a quarter inches across. Fig. 80 shows the variations of markings in the wings.

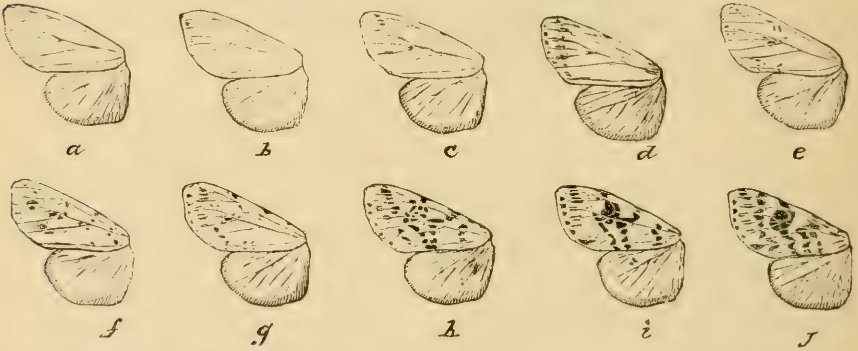


Fig. 80.—*Hyphantria cunea* Drury; ten variations in the markings of wings. From Div. of Entomology, Dep. of Agriculture.

The moths, which are only active at night, deposit their eggs in a cluster on a leaf, sometimes upon the upper, sometimes on the lower side, usually near the end of a branch (Fig. 81). Each cluster consists of a great number of eggs, which are deposited close together and in regular rows whenever the surface selected permits this. On an average each cluster consists of over four hun-

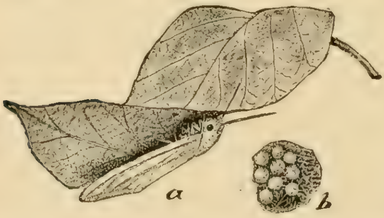


Fig. 81.—*Hyphantria cunea* Drury; *a*, moth depositing eggs; *b*, eggs. From Div. of Entomology, Dep. of Agriculture.

dred eggs. As the female deposits also eggs in smaller and less regular patches, we may say that five hundred eggs can be considered the real number produced by a single female. The eggs, measuring 0.4 mm., are of a bright golden-yellow color, quite globular, and ornamented by numerous regular pits, which give them under a magnifying lens the appearance of a beautiful golden thimble. Before the eggs hatch they change to a dull leaden hue. In the course of about ten days in cool weather, but much sooner when warm, these eggs hatch. Without check the offspring of one female moth might in a single season number 125,000 caterpillars in early autumn, enough to ruin the shade trees of many a fine street. This is reported from the fifth report U. S. Entomological Commission, but holds good only in regions where the insect is double brooded. Here, apparently, only one annual generation is found.

The caterpillars just born are pale yellow, with two rows of black marks along the body, a black head and with quite sparse hairs. When full grown they generally appear pale-yellowish or greenish, with a broad, dusky stripe along the sides; they are covered with whitish hairs, which spring from black and orange-yellow warts. The caterpillar is, however, very variable, both as to depth of coloring and as to markings, as is shown in Fig. 81.

Close observations have failed to show that different food produces changes in the coloration; in fact nearly all the various color varieties may be found upon the same tree. The fall generation is, however, on the whole, darker, with browner hairs than the spring generation.

As soon as the young caterpillars hatch they immediately go to work to spin a small silken web for themselves, which by their united efforts soon grows large enough to be noticed upon the trees. Under this protecting shelter they feed in company, at first devouring only the green upper portions of the leaf, and leaving the veins and lower skin unmolested. As they increase in size they enlarge their web by connecting it with the adjoining leaves and twigs; thus as they gradually work downwards their web becomes bulky, and as it is filled with brown and skeletonized leaves and other discolored matter, as well as with their own old skins, it becomes quite an unpleasant feature in our public thoroughfares, parks and orchards. The caterpillars always feed protected by these webs; but as soon as they approach maturity, which requires about a month, they commence to scatter, searching for suitable places in which to spin their cocoons. If very numerous upon the same tree the food supply gives out, and they are forced by hunger to leave their sheltering homes before the usual time. When the young caterpillars are forced to leave their webs they do not drop suddenly to the ground, but suspend themselves by a fine silken thread, by means of which they easily recover the tree. Grown caterpillars, which measure 1.11 inches in length, do not spin such a thread. Both old and young ones drop themselves to the ground without spinning when disturbed or sorely pressed by hunger. Favorite recesses selected for pupation are the crevices in bark and similar shelters above ground; in some cases even the empty

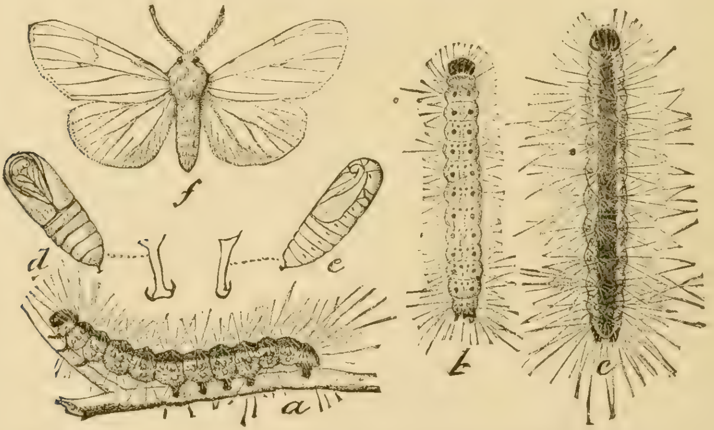


Fig. 82.—*Hyphantria cunea* Drury; *a*, *b*, *c*, differently marked caterpillars; *d*, *e*, pupæ; *f*, moth. From Div. of Entomology, Dep. of Agriculture.

cocoons of other moths. Fig. 82 shows different colored caterpillars, pupa and adult.

Passing the winter in the pupa state, the cocoons are found during the winter principally at the surface of the ground, mixed with dirt and rubbish, or in cracks and crevices of tree-boxes, in fences and under door-steps and basement walls. The first moths issue from these cocoons in May, and deposit their eggs in flat batches on the under side of the leaves. The young worms feed preferably in company, webbing first one and then several leaves together and gradually extending their sphere of action until a large part of the tree becomes involved. The worms become full grown in August.

Remedies:—Trees suffering from the attacks of this pest should be sprayed with London-purple or Paris-green. This will not be as effective as for most other insects, because the worms are protected by a web, which encloses the leaves they are feeding upon at the time, but as fresh leaves are constantly enclosed by the sheltering web the worms soon have to feed upon the poisoned ones and will be killed. If the branches are within reach the quickest method is to draw the branch through the hand and thus crush the worms and destroy their nest. If the branches carrying the web are still small, they may be cut off and thrown on the bare ground at a distance from the trees, or the worms may be crushed by stepping upon them. A good plan to destroy those nests, which are beyond reach of the hand, is to burn them with a torch of rags soaked with kerosene. It is even possible to destroy the majority of the worms in such a web by blowing them into space with a light charge of powder in a shot-gun. But whatever remedy is employed, it ought to be employed as soon as the nests become visible.

HICKORY TUSSOCK MOTH.

(*Halesidota caryn* Harr.).

Late in summer and all through the autumn, until late in September or until the leaves commence to drop, we find upon the hickory, apple, and other fruit trees and shrubs such as raspberries, etc., numerous caterpillars which are covered with short spreading tufts of white hairs, with a row of eight black tufts on the back and two long, slender black pencils on the fourth and on the tenth segments. The tufts along the top of the back converge on each side, forming a kind of ridge or crest; the warts from which these tufts proceed are oblong-oval and transverse, while the other warts on the body are round. The hairs on the fore part of the body are much longer than the rest, and hang over the head; the others are short as if sheared off, and spreading. The head, feet and under side of the body are black; the upper side of the body is white, sprinkled with black dots and with black transverse lines between the rings. These beautiful caterpillars are gregarious as long as young, but scatter later. When at rest they bend down the head and bring over it the long hairs on the fore part of the body; if disturbed they immediately roll up like a hedge-hog, and drop to the ground. The full grown caterpillars measure nearly one inch and a half in length. At this time they leave the trees, and move about in search of suitable shelters in which to make tkeir oval and thin cocoons, almost entirely composed of their own felted hair. The pupa is short, thick and rather blunt.

The winged insects appear during June, and are sometimes found in very large numbers upon the early flowers of our milk-weeds. The moths are of a light ochre-yellow color, varying greatly in intensity; the rather narrow forewings are long and pointed, and are thickly and finely sprinkled with little brown dots, and have two oblique brownish streaks passing backwards from the front edge, with three rows of yellowish-white, semi-transparent spots parallel to the outer margin. The hind-wings are very thin, transparent and without spots; the shoulder-covers are edged with light brown. The moths expand from one inch and seven-eighths to two inches and a quarter and more. At rest the wings are roofed; the antennæ are long, with a double, narrow, feathery edging in the males, and a double row of short, slender teeth on the under side in the females. These antennæ are rather longer than usual in Arctiids, and are not at all hairy. The tongue is a short spiral.

Another species of closely allied tussock moths is sometimes found feeding upòn the foliage of plums; the more usual food is, however, the scarlet-oak. This moth is called *Halesidota maculate* Harr., or the Spotted Tussock moth. It is of a light ochre-yellow color, with smaller and almost white spots arranged in about the same manner as the yellish-white spots in *caryæ*. The moth is a little smaller than the species described before. All three moths are shown on Plate XXI, Figs. 84 and 85.

THE CHECKERED TUSSOCK-MOTH.

(*Halesidota tesselata* S. & A.).

The caterpillar of this species is even more common, being found not alone upon the oak, but also upon plums, apples, raspberries and blackberries. In general appearance it is like *caryæ*, but the tufts are yellow, and the crest is a little darker; on the second and third segments are two orange-colored pencils, which are stretched over the head when the insect is at rest, and before these are several long tufts of white hairs; on each side of the third segment is a white pencil, and there are two pencils of the same color directed backwards, on the eleventh segment. The body is yellowish-white, with dusky warts, and the head is brownish-yellow. They transform in similar hiding places to pupæ which winter over. Fig. 83, Plate XXI, shows one of these caterpillars.

The moths are much paler than those of *caryæ* and *maculata*, being only faintly tinged with ochre-yellow. Their long, narrow, delicate and semi-transparent wings lie almost flat on the top of the back; the fore-wings are checkered with darker ochre-yellow dusky spots arranged so as to form five irregular transverse bands. The hind edge of the collar, and the inner edges of the shoulder-covers are greenish-blue, and between the latter are two short narrow deep-yellow stripes; the upper side of the abdomen and of the legs are deep ochre-yellow. The wings of this moth expand about two inches.

FAMILY LIPARIDÆ OR TRUE TUSSOCK-MOTHS.

Tussock-moths are of medium size; the antennæ of both sexes, when winged, are pectinated, those of the males very broadly so; the wingless females have serrate or narrowly pectinate antennæ. The adult moths are usually very plain in coloration; the legs are clothed with wooly hairs, and when the insect is at rest the fore-legs are always stretched forwards and are very conspicuous. In some the females are practically wingless, the wings being at most mere useless pads. Most are nocturnal, though the males of some fly during the day. The larvæ are the most beautiful of our caterpillars, being clothed with brightly colored tufts of hairs.

THE WHITE-MARKED TUSSOCK-MOTH.

(*Orgyia leucostigma* S. & A.).

This caterpillar looks quite different from those of the other Tussock-moths described before. It is not a common insect in Minnesota, but is rapidly increasing in numbers.

At present it is almost entirely confined to our cities, where the caterpillars feed upon the foliage of such shade-trees as the soft maples, poplars, and cotton-wood. It is not unusual to find fastened to the trunks of such trees grayish cocoons, to which are usually fastened a mass of glistening white eggs. These latter attract the attention of the passer-by, who would not be apt to detect as readily the grayish cocoons of the males. Where these caterpillars have found a home in our orchards, the cocoons can also be detected late in autumn, or after the leaves have fallen, by investigating the dead leaves still fastened here and there to the branches of the trees; these almost invariably contain cocoons of such insects.

The eggs, which are deposited upon the outside of the cocoon, simply because the wingless female finds this the nearest and best place for this purpose, are found to be arranged in three or four layers; they are covered with a frothy mass that serves to protect them. From 300 to 500 eggs are found together; each egg is of a white color, nearly globular, and flattened on the upper surface. The eggs remain in this condition over winter, and hatch about the middle of May, when the young caterpillars immediately proceed to ascend to the foliage of the tree upon which they were born. These caterpillars are frequently called "Drop-worms," because they have the habit, when disturbed, of letting themselves down by a silken thread, remaining suspended until the danger is past, when they climb up again "hand over hand" to reach the leaf.

There are few caterpillars that are as handsome as this one, in spite of what may be said about worms never being beautiful. They are more than an inch long, of a bright yellow color, with the head and two small protuberances on the hinder part of the back of a brilliant coral-red. Along the back we see four cream-colored brush-like tufts, two long black plumes on the anterior part of the body, and one on the posterior. The sides are clothed with long and fine hairs.

A narrow black or brown stripe extends along the back, and a wider dusky stripe on each side. The peculiar cup-like, coral-red protuberance already mentioned are scent-organs used by the caterpillars to drive off enemies; they are used in a similar way as the whip-like organs found in the caterpillars of the swallow-tailed butterflies described before. As soon as the caterpillars reach their full size they descend to the trunk, or move to tree-boxes or fences, to find shelters in which to spin their cocoons, which are loosely made of silk and their own hair. It is a strange fact that the female caterpillar sheds her skin once more than the male. In Minnesota we have but one annual brood, at least in St. Paul and Minneapolis; further south two broods are the rule.

The brownish pupæ of the two sexes differ very considerably, the male being much smaller than the female; both are covered with short hairs.

The moths differ still more, the male being winged, with very broad and feather-like antennæ, while the female is wingless, possessing slender antennæ. The female is simply provided with the merest rudiments of wings, which are perfectly useless; her body is of a light-gray color, oblong-oval, with long legs, and is greatly distended with eggs. After leaving the pupal shell she does not leave the outside of the cocoon, but patiently awaits the male, when, after pairing, she commences to deposit her eggs in the manner already described; during this process her body shrinks more and more, and finally she drops down to the ground and dies as soon as her work is finished. The male moth is of an ashen-gray color; the fore-wings are crossed by wavy bands of a darker shade. There is a small black spot on the outer edge near the tip, an oblique blackish stripe beyond it, and a minute very characteristic white crescent near the outer hind angle. The gray body has a small black tuft near the base of the abdomen. The wings, when expanded, measure about an inch and a quarter across.

The males of some species of this genus of moths are diurnal in their habits, or fly swiftly during the brightest part of the day. Not so with *leucostigma*. Here the male rests during the day, and assumes a very characteristic position, as shown in the illustration, Fig. 87 and in Plate XXI.

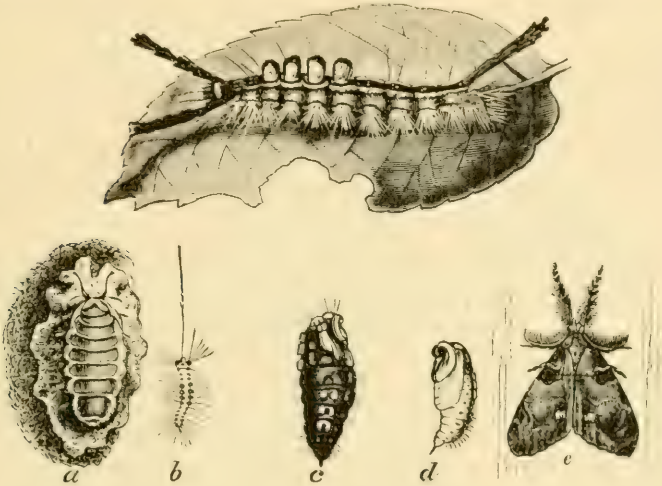


Fig. 87.

Fig. 87.—*Orgyia leucostigma* S. & A.; *a*, adult female on egg-mass; *b*, young caterpillar; *c*, female pupa; *d*, male pupa; *e*, male adult; above full grown caterpillar. From Div. of Entomology, Dep. of Agriculture.

The long and very peculiarly tufted forelegs are very conspicuous in this position, and as the colors of the moth blend well with the spot selected for rest the insect is not easily detected.

Remedies:—As the cocoons attached to the leaves or to the trunks of trees, sides of buildings, projecting roofs, under fence boards, etc., are easily detected, the eggs fastened to them can be collected in very large numbers and destroyed. But as the cocoons very frequently contain parasites it is best not to destroy them, but after having collected them to put them in an open box away from the trees. In this way the parasites can hatch and fly away, even the male moths may escape, but as the female moth has no wings there is no danger that she can reach a tree some distance away. Spraying with arsenical poisons will also kill these voracious caterpillars.

THE PARALLEL-LINED TUSSOCK-MOTH.

(*Parorgyia parallela G. & R.*).

Another caterpillar, also ornamented with long pencils of hairs, feeds upon the plum, crab-apple, oak and other trees. It is sometimes quite common. It has a gray body, with a dorsal and stigmatal black line. The black pencils or tussocks are found on top of segments 4, 5, 6 and 7, the latter one is sometimes wanting; on each side of the first and last segment is a pencil of long black hairs; on top of segment 11 is also an apparently double brush of black hairs. The hair on the sides of the body is yellowish, in spreading clusters; on top of segments 9 and 10 is a small pale yellow cup. The head is of a shining-black. When full grown this caterpillar measures an inch and a half. It now searches for a protecting shelter, and here spins a coarse cocoon, inside of which it changes to a pupa. In *Parorgyia* both sexes are winged. The moths are dark gray, with darker colored wavy lines and spots; there is a dark blotch between the outer line and the apex. They resemble the males of *leucostigma*, but are a little darker and larger, as shown in Fig. 88, Plate XXI.

THE GYPSY-MOTH.

(*Ocneria dispar* Linn.).

This is also related to the Liparidæ. It is a European moth, which was imported into Massachusetts in 1868, and which has already caused enormous damage to that state, requiring annual appropriations of many thousands of dollars, simply to keep it from spreading. It is not found in Minnesota, notwithstanding letters received from time to time, and it is to be hoped will always remain a stranger to

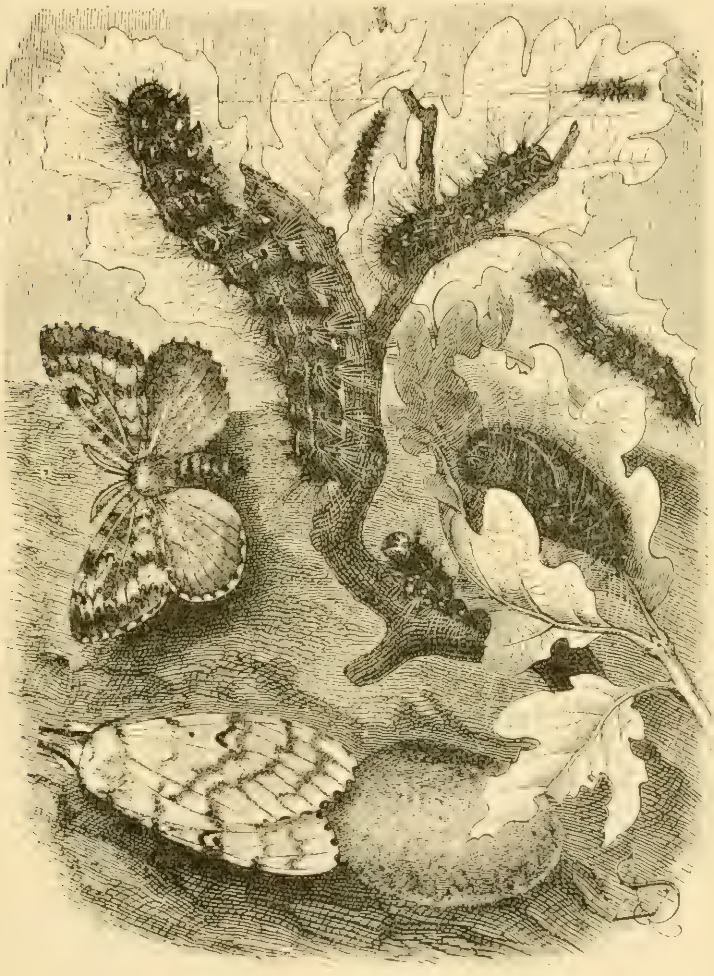


Fig. 89.—*Ocneria dispar* Linn.

our state. Its caterpillar, when full grown, is about one and one-half inches in length, of a creamy-white color, so thickly sprinkled with black that it seems dark-brown, the ground color appearing in the broken dorsal and lateral lines. It is furnished with distinct dorsal and lateral tubercles, blue anteriorly and crimson behind the fifth segment, from each of which arise tufts of long black and yellowish hair. The caterpillar changes to a chocolate-brown pupa, covered by a few threads, forming the merest apology for a cocoon. The male moths are brownish-yellow, the fore-wings are smoky, with darker irregular transverse lines; the hind-wings are paler with a darker outer-margin. The heavier and much larger female moths are creamy-white in color, with irregular transverse gray or blackish lines. The males measure with expanded wings from one and one-half to two inches, the females two and one-half inches. The moths appear from July to September. The females deposit their eggs in masses of from four to five hundred in all conceivable localities, and cover them with yellow hair and scales from the end of their abdomen. The insects winter as eggs, which hatch from April to June.

FAMILY MEGALOPYGIDÆ OR FLANNEL-MOTHS.

Prof. Comstock has, for good reasons, separated from the *Liparidæ* a number of moths, which he places in a new family, the *Megalopygidæ* or *Flannel-moths.* They are whitish-moths which have their wings densely clothed with long and curly hairs, resembling bits of flannel. Their larvæ are also remarkable for the possession of ten pairs of legs, three thoracic and seven abdominal, while all other known lepidopterous larvæ have lost some of their abdominal legs. The cocoons are furnished with a trap-door.

THE WAVED LAGOA.

(*Lagoa crispata* Packard).

This peculiar caterpillar is quite uncommon in Minnesota, where it feeds upon a variety of plants, but especially upon the blackberry, apple and raspberry. Being quite uncommon it probably will never be classed among the injurious insects. It is nearly oval, covered with evenly shorn hairs of a brownish color, which are raised to a ridge along the middle of the back, sloping off on each side like the roof of a house. When about three-fourths of an inch long, the caterpillar ceases to feed and forms now a tough, oval cocoon, which is fastened securely to the side of a twig upon the foliage of which it has been feeding. This cocoon is fastened very securely and can only be removed by applying some force. Inside this cocoon the caterpillar changes to a brown pupa.

The moth issues during July of the following year, and escapes by lifting a flat and circular lid on one end of the cocoon. It is a soft looking yellowish-cream or straw-yellow being; the fore-wings are more or less dusky on the outer margin, covered with fine, flattened, curled hair-like scales, arranged in regular waves, running from near the base to the tip. The body and legs are thick and woolly; at the tip of the abdomen there is a tuft of long and soft hairs, forming a bushy tail. The moth, with wings expanded, measures about one and three quarter inches across. It is shown in Fig. 90, Plate XXI.

A closely related species, the *Lagoa opercularis* S. & A., is found in our Southern States. The moth resembles very closely the waved Lagoa. Its cocoon is about as interesting an object as we can find, and so closely resembles a terminal bud of the Life Oak, upon which the caterpillar is usually found, that it is almost impossible to detect it, especially as both twigs and cocoons are covered with small bits of lichen. The larva, pupa and adult of this interesting moth is shown in Fig. 91.

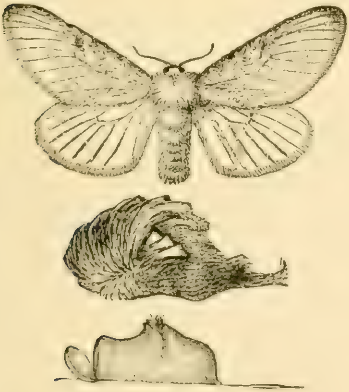


Fig. 91.

Fig. 91.—*Lagoa opercularis* S. & A.; larva, cocoon and adult. From Div. of Entomology, Dep. of Agriculture.

FAMILY LIMACODIDÆ OR SLUG-CATERPILLARS.

A number of very interesting modest green or brown moths, usually of a small size, and very densely clothed with scales or hairs, form this family. They possess a much reduced head and have no tongue. The larvæ are very peculiar slug-like beings, usually flattened and oblong in shape, with no apparent legs; they move like slugs or snails, the prolegs being replaced by mere swellings on the abdominal segments. Some of these innocent or grotesque looking caterpillars can cause a burning pain like that produced by nettles; it is caused by the breaking of certain hollow spines filled with a powdery dust or which contain the same urticating acid in a liquid form.

THE GREEN SLUG-MOTH.

(*Parasa chloris* H. Sch.).

The caterpillar (Fig. 92, Plate XXII,) of this insect feeds upon cherry, apple and rose. It is of a bright scarlet color, with four dark blue-black lines along the back, and with prickly yellow horns or tubercles, which possess the power of stinging; the head is retractile. The ground-color of this caterpillar differs greatly, however, and in some cases it is yellowish or yellowish-brown. Like most species of Limacodidæ this caterpillar forms an egg-shaped cocoon, which is dark brown, smooth and very thin; in it the caterpillar hibernates, not changing to a pupa until spring.

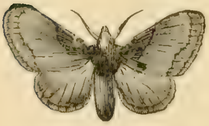


Fig. 93.

Fig. 93 –*Parasa chloris* H. Sch.; From Div. of Entomology, Dep. of Agriculture.

The moth is very pretty, have thing abdomen and hind-wings fulvous, the thorax and front-wings delicate green, the latter bordered posteriorly with brown, and having a patch of the same color at the base, one-third as long and one-half as wide as the wing itself. (Fig. 93).

A similar moth, the *Euclea pænulata* Clem., is not uncommon in Minnesota. A single caterpillar, found also upon the cherry, was bred in captivity, and proved to be this insect. The moth has a dark brown body, and the green marks of the front-wings are narrow and of a brighter green than in *chloris*. It is shown in Fig. 94, Plate XXII.

Still another moth is found from time to time near the electric light. It is *Euclea cippus* Cram. var. *quercicola* H.S. Its larva feeds upon apple, plum, cherry and some other plants, but is not common. The moth is also dark brown; the large green band on the fore-wings is in this case simply indicated by a number of large and small green spots, the one nearest to the body being larger and of a triangular shape. Fig. 95, Plate XX, shows two slug-caterpillars.

THE CHERRY SLUG-CATERPILLAR.

(*Adoneta spinuloides* H. S.).

The slug-like caterpillars of this moth are very curious grass-green objects, which, with their flat bodies ornamented with a few reddish lines, almost look like excrescences of the leaf. They move by a sliding and almost imperceptible motion. When mature they form very small and almost perfectly globular brown cocoons, fastened to leaves or twigs. In this condition they remain until spring, when they transform to pupæ and soon afterward to moths. (Fig. 96, Plate XXII). These are distinguished by a uniform dark brown color, with irregular bands of whitish spots. The rather falcate fore-wings are edged with brown and white. This insect is also uncommon, still a single small cherry tree was found, upon which several hundreds of these caterpillars were feeding. A rapid increase of this insect is not likely to take place, as but few of the caterpillars escape parasitic insects. Among these is a rather large and peculiar fly, the *Systropus macer* Loew, which is apparently much more bulky than the insect in which it fed.

SADDLE-BACK CATERPILLAR.

(*Empretia stimulea* Clem.).

The odd shape and very peculiar coloration, which is decidedly saddle-shaped, render this caterpillar a very striking object, and never fails to excite the wonder of those not versed in such things. But it sometimes excites something else than wonder! If handled roughly or carelessly the caterpillar can cause very severe pain. The thorn-like hairs, which grow upon it, sting like nettles, and when applied to the back of the hand, or to any other part where the skin is tender, the parts touched swell with watery pustules. The irritation caused by the acid in these thorns is sometimes exceedingly severe, and with some persons becomes a serious matter; first inflammation, next swelling, and in extreme cases a numbness or even partial paralysis of the entire arm. A prompt application of ammonia or bicarbonate of soda acts as an antidote, and soon allays the pain. This peculiar caterpillar is of a reddish-brown color, rounded above, flattened beneath, armed with prickly thorns, which are largest on the fourth and tenth segments, and with a bright pea-green patch, resembling somewhat a saddle in form, over the middle portion of the body, centred with a broad, elliptical, reddish spot, the red spot and green patch both being edged with white. The under part of the body is flesh-colored. Ths caterpillar possesses six true legs but no prolegs.

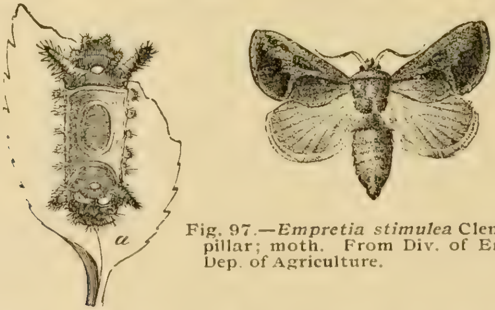


Fig. 97.—*Empretia stimulea* Clem.; *a*, caterpillar; moth. From Div. of Entomology, Dep. of Agriculture.

The moths are of a deep, rich, reddish velvety-brown color, with a dark streak along the middle, extending from the body half-way across, and on this is a golden spot; two other golden spots are on each wing near the apex. With expanded wings the moth measures nearly an inch and a half across.

These caterpillars are very general feeders, having been found on corn, sumach, rose, apple, grape, currant, cherry, raspberry and blackberry. Not being common, and much infested by parasites, it is not to be feared as a very noxious insect. Larva and moth are shown in Fig. 97.

THE HAG-MOTH CATERPILLAR.

(*Phobetron pithecium* A. & S.).

This is one of the most curious caterpillars known. Its slug-like actions, as well as its oblong or nearly square, flattened body of a dark brown color, make it a remarkable object. Its body is covered with eight singular fleshy appendages protuding from the sides. The three middle ones are longest, measuring about half an inch; they have their ends curved. When such caterpillars are roughly handled some or all of these fleshy horns become detached. The full grown larva spins a small round and compact cocoon, and to its outside the horns are fastened; the cocoon itself is usually fastened to a twig of the tree on which the caterpillars feed.

The moth is very uncommon. It is of a dusky purple-brown color, with ochreous patches on the back and a light yellow tuft on the middle pair of legs. The abdomen is sable, ending in a tuft of ochreous scales. The fore-wings are variegated with pale yellowish-brown, and crossed by a narrow, wavy, curved band of the same color, edged near the outer margin with dark brown, and having near the middle a light brown spot; the antennæ in the male are very broadly pectinated and the remarkably long and narrow fore-wings are partly transparent. The hind-wings are sable, bordered with ochreous in the female. The moth measures with expanded wings a little over one inch. This caterpillar feeds upon the cherry, plum, apple and oak. Larva and pupa are shown in Fig 98.

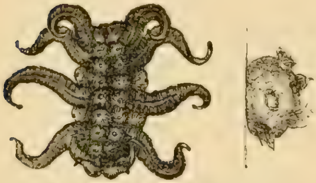


Fig. 98.—*Phobetron pithecium* A. & S.; caterpillar and cocoon. From Div. of Entomology, Dep. of Agriculture.

Mr. Hubbard, in "Orange Insects," gives the following account of this peculiar insect. "This insect receives its name from the curious hairy appendages which cover the back and project from the sides of the larva and have a backward twist, like locks of disheveled hair. They are, in fact, fleshy hooks, covered with feathery, brown hairs, among which are longer, black, stinging hairs. The cocoon is almost spherical, and is defended by the hairy appendages which the larva in some way contrives to leave upon the outside. These tufts give to the bullet-shaped cocoon a very nondescript appearance, and the stinging hairs afford a very perfect protection against birds and other insectivorous animals. Unlike other species of *Limacodidæ* the Hag-moth larvæ do not seek to hide away their cocoons, but attach them to leaves and twigs fully exposed to view, with, however, such artful management as to surroundings and harmonizing colors that they are of all the group the most difficult to discover. A device to which this insect frequently resorts exhibits the extreme of instinctive sagacity. If the caterpillar can not find at hand a suitable place in which to weave its cocoon it frequently makes for itself more satisfactory surroundings by killing the leaves upon which, after they have become dry or brown in color, it places its cocoon."

THE SKIFF-SHAPED LIMACODES.

(*Limacodes scapha* Harr.).

The caterpillar of this moth is also very peculiar in form, being boat-shaped and triangular; it is green, spotted above with brown, pale beneath, the sides raised, and the dorsal surface flattened. Late in autumn it forms a tough, rounded, oval cocoon. The moth appears in June; it deposits the eggs singly, and the larva often live on the upper side of the leaves. The caterpillar of this species is also a rather general feeder, being found upon apple, plum, cherry, hickory and oak. It is such a curious being that a more detailed description of it is quoted from H. Edwards and Elliot. "Ground-color pale apple-green. The segments extended laterally in the middle of the body, and raised into an elevated ridge, sharp and angular at the edges. The flattened portion, which includes the dorsal region, is chestnut brown, darker on the margins. There is also a darker dorsal stripe. The segments are arranged like the plates of a tortoise. The latter region is of a pale yellowish-green, with an oval white spot on segments 9 and 10. Spiracles pale brown, mouth parts also brown. In some specimens the brown color of the back is reduced to small patches, and occasionally a yellow dorsal line is present, the ground color (pale-green) then prevailing. Length 0.85, width 0.25 inch.

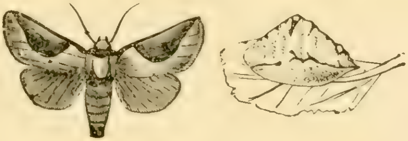


Fig. 99.—*Limacodes scapha* Harr.

"The moth is light cinnamon brown; on the fore-wings the costa-median region is filled in with a large tan-brown triangular spot, ending on the tip of the wing, and is lined externally with silver. Expanse of wings, 26 to 28 mm."

Moth and caterpillar are shown in Fig. 99.

THE FASCIATED LIMACODES.

(*Lithacodes fasciola* H. S.).

This slug-caterpillar, as well as that of *Tortricidia flexuosa* H. S , are quite common in some years, and are rather general feeders. Both occur on the plum, cherry, apple, hickory, oak, linden and other trees. They cause but little damage, as they eat but little. There are still other species of Limacodidæ found upon our fruit trees, but as all are very similar in general habits and appearance it is not necessary to describe them in detail.

The caterpillar of *fasciola* is elliptical, the posterior end quadrate. The dorsal space is broad and flat; the lateral one broad and oblique. There is a slight, smooth and yellowish-green subdorsal ridge, and yellow subdorsal and lateral lines, of which the latter is broken. The depressed spaces are pale-yellow, with green centres. Length 7-13 mm.

The moth (Fig. 100) has ochreous-brown fore-wings, with a dentate white band running across the middle, followed by a blackish shade; there is a curved black line from the white band on the costa to the hind angle; the hind-wings are blackish or pale testaceous. Expanse 15-20 mm.

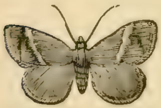


Fig. 100.—*Lithacodes fasciola* H. S.; moth From Div. of Entomology, Dep. of Agriculture.

The caterpillar of *T. flexuosa* is elliptical; the dorsal space is almost uniform in width; the lateral space is broad and oblique; the dorsal ridge is very slight. Color pale yellowish-green, clearer at the sides. Subdorsal line yellow, as well as all the depressed spaces in the bottom, the largest with green centers. A number of very variable red spots and marks occur in the dorsal space, but the usual form is that of a rounded cross, of crimson color, marked with purplish-brown and blackish on the ridges.

All these species are single brooded, and can be found late in autumn, almost invariably on the under sides of the leaves, in which they eat large holes. All spin almost globular, brown and very thin-shelled cocoons, inside of which they hibernate as caterpillars, which do not transform to pupa until late in spring, and which soon afterward leave the cocoon, as moths, by round holes covered with perfectly fitting lids.

FAMILY PSYCHIDÆ OR BAG-WORM MOTHS.

As far as known none of these peculiar moths occur in Minnesota, though the writer has repeatedly received the peculiar bags from nurserymen, who had detected them on stock received from more southern states. The caterpillar builds for itself a silken sack covered with little twigs or bits of leaves. In this bag, which is made as soon as the worm hatches from the egg, it lives as in a house; it drags it always with it like a snail, and fastens it by strong silken cables wherever it intends to feed. For the sake of those interested in the study of lepidoptera the bag of the common bag-worm (*Thyridopteryx ephemeræformis* Steph.) is shown in Fig. 101.

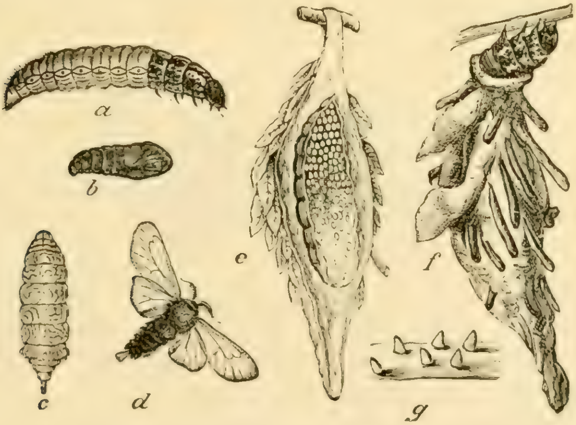


Fig. 101.—*Thyridopteryx ephemeræformis* Steph ; *a*, caterpillar; *b*, male pupa; *c*, female adult; *d*, male; *e*, female pupa filled with eggs; *f*, caterpillar in bag; *g*, young caterpillars carrying bags. From Div. of Entomology, Dep. of Agriculture.

FAMILY LACOSOMIDÆ.

Opon our low bushes of oak we find not rarely another peculiar house made by a caterpillar. It is the home of *Perophora Melsheimerii* Harr. Formerly this insect was classed among the insects belonging to the above family, but for very good reasons it forms now a family by itself, the *Lacosomidæ*. The moth is shown in Fig. 102 and the caterpillar in large illustration Fig. 134.

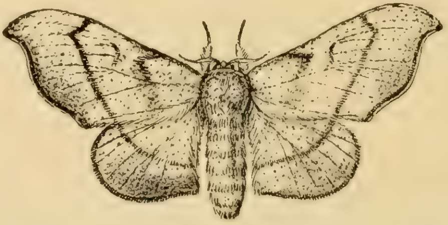


Fig. 102.—Perophora Melsheimerii Harr. Original.

FAMILY NOTODONTIDÆ OR PROMINENTS.

This family includes moths of moderate size, only a few expanding more than two inches. Their body is stout, densely clothed with hair, of which those on the femora are unusully long. The strong wings are not very broad; the fore-wings have in many cases a tooth-like prominence on their inner margins. Many of the caterpillars have also peculiar humps, and thus become very prominent. They are either naked, or only thinly covered with hairs, and usually make slight cocoons or enter the ground for pupation.

THE SPHINX-LIKE APATELODES.

(*Apatelodes torrefacta* A. & S.).

This interesting moth is fairly common in Minnesota, but by no means sufficiently so to cause any great injury. Its caterpillar feeds upon blackberry, wild cherry, plum, hazel, ash, willow and other plants. It is a very general feeder, hence varies in this respect from most of the other prominents. The hairy caterpillar is very conspicuous, and easily detected, as it feeds exposed on the leaves.

Prof. Beutenmueller gives the following detailed description of it: "Head dirty white. Body creamy white with a broken black dorsal stripe on which are tufts of hairs of the same color. A black spot on each segment along the sides. Body covered with long, white, flossy hairs directed backwards, except those on the anterior segments, which are directed forwards. On the back of each of the second, third and eleventh segments is a long, mouse-colored pencil, tipped with white at the ends. Abdominal legs black, the extremities pinkish. Thoracic feet black. Sometimes the body is pale yellow with the hairs bright sulphur yellow, with the pencils ferruginous, tipped with black. Sometimes the body is black with the hairs Maltese gray. Length 45 mm."

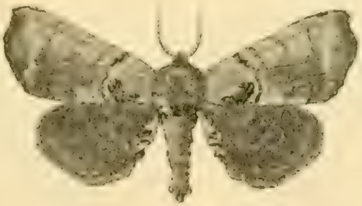


Fig 103. Apatelodes borrefacta A. & S.

Moth:—Fore-wings ash-gray, clouded outwardly with smoky brown. Across the basal third are two brown, parallel, wavy, narrow, transverse lines, and two similar ones across the outer third. On the inner margin near the base is a deep brown patch, and a small white spot beneath the apex. Hind-wings dull reddish, sometimes washed with ashen-gray, and with two ill-defined, transverse lines, the outer one whitish and marked at the inner angle with two deep brown dashes. Head and thorax ashen-gray, the latter with a deep brown band across the posterior part.

Abdomen gray, and tuft tipped with deep brown. Expanse, male, 36-40 mm.; female, 50 mm. The moth is illustrated in Fig. 103.

THE YELLOW-NECKED APPLE TREE CATERPILLAR.

(*Datana ministra* Drury).

This insect is not very common in our state, but is evidently on the increase in nurseries and orchards, and wherever found is quite destructive. It has found a home in some of our nurseries, where it can seriously injure the young trees, especially as the caterpillars are gregarious and thoroughly strip the infested plants of all foliage. When young they eat only the under side and softer part of the leaves, leaving veins and upper side untouched, but as they grow older and stronger the entire leaf, with the exception of the stem, is eaten. When full grown, which requires from five to six weeks, they measure about two inches in length. They have a large and black head; upon the next segment the cervical-shield, sometimes called the neck, is of a dull orange color. Upon the back of the caterpillar we find a black stripe, and on each side are three stripes of black, alternating with four yellow stripes. White hairs, which are very long and soft, thinly clothe the body. As already mentioned the caterpillars are always found clustered to-

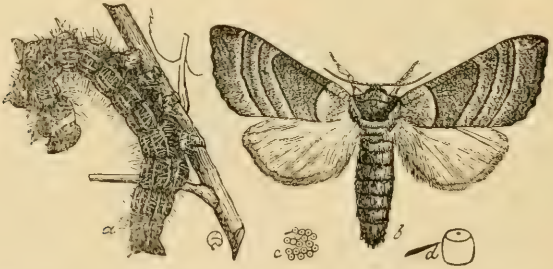


Fig. 104.—*Datana ministra* Drury; *a*, caterpillar; *b*, adult; *c*, eggs; *d*, egg enlarged. After Riley.

gether on a limb of the tree, and there form sometimes large bunches of worms. Each larva, when at rest, assumes a very odd and characteristic position; both extremities are raised, the body is bent, and rests only on the four pairs of prolegs, as shown in Fig. 104, *a*. If touched or otherwise alarmed they throw up their heads and tails with a jerky motion, at the same time bending the body until the two extremities almost meet over the back; they also sway their bodies from side to side. These jerky motions are intended to drive off marauding parasites, but frequently with but little benefit, as large numbers of the caterpillars are killed by such parasitic insects as the Tachina-flies. All caterpillars feed together, crowded upon the under surface of the leaves, and if we look closely we see along the margins a row of their shining black heads. When mature they all leave the tree, descending by night to the ground, where they burrow under the surface to a depth of from two to four inches. Here they change to naked brown pupæ, not enclosed in any silken cocoons whatever, and here they remain until the following July when the moths emerge.

Each female deposits from seventy to one hundred eggs in a single cluster on the surface of a leaf. Each egg is white and round, and all are placed firmly cemented together side by side in regular order.

The moth is of a reddish or russety-brown color, with the head and a large spot on the thorax chestnut-brown. The fore-wings are crossed by three to five transverse darker brown lines, one or two spots are near the middle, and the outer-margin is also of the same color. The hind-wings are pale-yellow and without markings. When the moth is at rest it has the posterior part of the body raised up and the fore-legs stretched out at full length. Both sexes of the moths are also shown in Fig. 105, Plate XII.

As this insect is seldom very numerous hand-picking at the proper time is all that is required. This is very easy, as the caterpillars feed together, and also cluster on the trunk or lower branches during the moulting period, when the whole colony can be destroyed by crushing or burning.

There are a number of other species of the genus *Datana* which occasionally cause injury to our fruit-trees. Last summer (1898) two species were found in large numbers and were quite destructive to plums; the caterpillars had a somewhat different color but none could be reared to their winged form. All species of this genus have but one annual brood.

THE WALNUT CATERPILLAR.

(*Datana angusii* G. & R.).

This species closely resembles the *ministra*, but is a distinct kind, which is sometimes so destructive to our walnut and hickory trees, in the latter part of summer that they become denuded of all their leaves. The caterpillars are dark with light stripes along the sides. They assume the same peculiar position when at rest as the other species of Datana.

Two other species of Datana are found feeding upon the foliage of the apple, walnut, hickory and oak, i. e. *Datana integerrima* G. & R., and *Datana contracta* Walk.

The caterpillars of all the species of this genus have the habit of descending to the trunk of the tree to within a few feet of the ground, when about to moult, and to congregate here in a large mass. Large numbers of their cast-off skins are often very conspicuous after such moults and after the worms have disappeared long ago. It is, of course, very easy to capture at such times the whole colony and to destroy it. The application of arsenical preparations is of little use, unless the whole tree can be sprayed. But in nurseries, where the trees are still small and close together, it is in some cases advisable to apply such insecticides that do not alone kill the species of *Datana* but also the numerous other worms that eat their leaves.

Prof. Beutenmueller gives the following description of the species:

Datana angusii G. & R.

Moths:—Fore-wings varying from chocolate to deep smoky brown, differing in this respect from all the other species of this genus. Along the costal region the color is of a shade darker than the rest of the wing. Lines like those of *D. ministra*. Hind-wings paler. Thoracic patch very deep brown. Expanse 35-45 mm. Fig. 106 shows this moth.

Caterpillar:—Head and cervical-shield jet black, shining. Body black with three equidistant, very narrow, pale yellow or whitish stripes on each side, very much narrower than the intervening spaces. Under side with three yellow stripes,—one along the middle, which is the broader and one on each side, broken by the legs. Abdominal legs and spots on the legless segments reddish. Thoracic feet black. Hairs on the body dirty white. Length 55 mm.

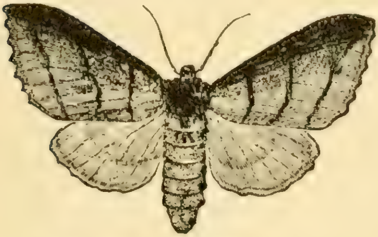


Fig. 106.—*Datana angusii* G. & R.

Datana integerrima G. & R.

Moths:—Fore-wings light brown with five transverse lines, followed by light shades. Over the wings are fine darker irrorations. Outer margin even, in the male, very slightly scalloped in the female, which is of a paler shade. Two discal spots. Thoracic patch dark ochreous. Hind-wings paler. Expanse, 35-45 mm. Fig. 107, Plate IV, shows this moth.

Caterpillar.—Body wholly black, covered with long, floss-like, white hairs. Sometimes there are visible a subdorsal, ill-defined, white stripe, a rather broad, wavy, lateral stripe and one along the middle of the under side. Head jet black, shining, rarely chestnut red. Abdominal legs black outside and reddish-brown inside. Length, 55mm.

Datana contracta Walker.

Moth.—Pale tawny luteous, with numerous dark brown or blackish irrorations. Lines as in *integerrima*. Discal spots present. Hind-wings and body pale luteous. Thoracic patch dark ochreous. Expanse, 35-45 mm.

Caterpillar.—Head black. Cervical-shield orange. Body black with four creamy-white stripes along each side, as wide as the intervening spaces, and three stripes beneath. Abdominal legs yellowish-brown, extremeties black, and with yellowish-brown spots on the legless segments. Thoracic feet black, bases yellow-brown. Length, 55mm. Fig. 108, Plate IV, shows this moth.

THE RED-HUMPED CATERPILLAR.

(*Œdemasia concinna* S. & A.).

As far as habits are concerned this insect resembles the Yellow-necked Apple-tree Caterpillar very much. The fore-wings of the moth are dark brown on the inner and grayish on the outer margin; they have a dark brown dot near the middle, and a spot near each angle, and several longitudinal streaks of the same color along the hinder margin. The hind-wings of the male are brownish, those of the female

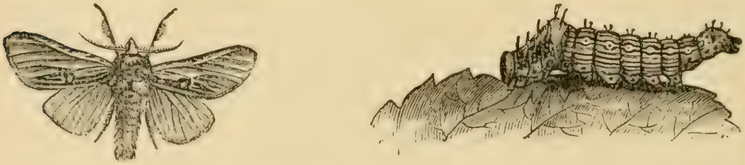


Fig. 109.—*Œdemasia concinna* S. & A.. Moth and caterpillar.

dusky brown; the body is light brown, the thorax of a darker shade. With wings expanded they measure an inch and a quarter across.

The female, which appears late in June, deposits her eggs in a cluster on the under side of a leaf. The tiny caterpillars at first only consume the substance of the under side of the leaf, but as they soon increase in size they devour the entire leaf. When not engaged in eating they huddle closely together and frequently completely cover the branch upon which they rest. While resting the posterior part of the caterpillar is always elevated. The young caterpillars are similar to, but lighter colored than the mature ones. These latter are greenish-yellow or yellowish-brown; the head and a prominent hump on the back of the fourth segment is coral-red. The body is striped longitudinally with dark brown or black lines; or, considering all the colors, with yellowish, white and dark lines. A double row of black spines extends along the back, and five black points are found on each side of the segments, three above the spiracles and two below. The back is marked with five narrow black lines; the sides from the fifth to the tenth segment, inclusive, are whitish with black lines above the spiracles. The first three segments are spotted with black and white; the last segment is spotted with black. The legs are black; the prolegs black and yellow, the last segments taper a little. When full grown the caterpillar is one inch and a quarter long.

These caterpillars are gregarious, and soon defoliate the branch on which they were born. When handled they discharge a transparent fluid which possesses a peculiar acid smell and which no doubt serves as a defense against enemies, especially birds, which can readily see these caterpillars so openly exposed in large numbers.

When mature the larvæ descend to the ground, where they conceal themselves under leaves upon or slightly under the surface. Here they surround themselves with a very thin cocoon, of a silky texture, yet looking more like a cell made of glue than of silk, inside of which they change to a brown pupa, which remains in the cocoon until the next year. Both larva and adult are shown in Fig. 109; the larva also in Fig. 110, Plate XIV.

These caterpillars are rather general feeders, being found upon the apple, their favorite food, but also upon plum, cherry, rose, shad-berry, *Wistaria* and other plants. As they are gregarious during their entire larval existence and can readily be seen, they can be easily detected and destroyed, especially in nurseries, where the limb inhabited by them can be cut off and where the worms can be trampled under foot. A sudden jar of the limb will also bring the caterpillars to the ground where they can be killed.

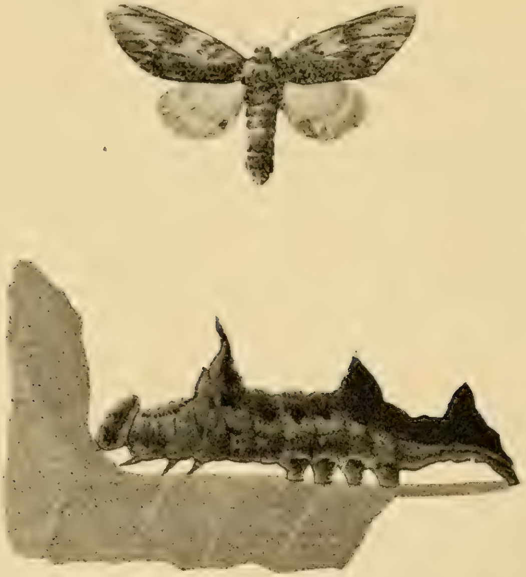


Fig. 111.—*Œdemasia eximia* Grote; moth and larva. After Packard.

Another species, the *Œdemasia eximia* Grote., occurs also on the apple, willow, maple and other trees.

The moth (Fig. 111) resembles *concinna*, but is a little larger, with longer and more produced wings. Its fore-wings are ashen-gray, with dashes of ochreous brown; the inner margin for two-thirds of the width of the wing is purplish-brown; there are no transverse lines; the very small discal spot is round and black and a short black dash is found at the base of the wing. The hind-wings are grayish-brown, darker in the female.

The caterpillar has a dirty white head, with a band on each side composed of brownish-black spots, dotted with red. The body is pale brown, with a brownish-olive shade along the back, quite distinct on the last four segments, and frequently quite greenish. The distinct V-shaped mark is pinkish; an oblique olive-brown line runs from the base of the long and fleshy tubercle on the fourth segment backwards to the anterior part of the leg on the sixth segment. This movable tubercle is long, with the distal half slender. A slight hump occurs on the eighth and a larger one on the twelfth segment.

THE UNICORN PROMINENT.

(*Schizura unicornis* S. & A.).

The caterpillar of this moth is also a very peculiar being. It is brown or reddish-brown with a pea-green patch on each side of the first three segments, and variegated with white on the back, with a large brown head. The fourth segment is furnished on the upper side with a long, horn-like and acute tubercle with two small tubercles at the tip and from the possession of this horn the species has been named. On the eighth segment is a slight hump with two small warts and on the last segment is a rather large dorsal hump supporting two warts. On the body are a few short and scarcely visible hairs. The last segment and the last pair of feet are always raised when the caterpillar is at rest, but are used when walking. These odd-looking worms are not common, but may be found during August and September when they have reached their full size. According to Saunders, the caterpillar "at first eating a notch, about the size of its body, in the side of the leaf on which it is feeding, and placing itself in this notch, with the humps on its body somewhat resembling the irregularities in the margin of the partly eaten leaf, is not easily detected." Yet notwithstanding this similarity to the edge of the leaf, expressed still more so by a similar caterpillar, that of the related *Ianassa lignicolor*, there are few worms that are as thoroughly parasitized by Tachina-flies as these apparently so well hidden and protected ones. The mature caterpillars measure an inch and a quarter in length. They do not possess the gregarious habits as some of those already described, being either found singly, or three or four together on the same twig. Towards September the caterpillar descends to the ground, and here it constructs under fallen leaves or other rubbish a thin and almost transparent papery cocoon and very much later it changes to a brown pupa, in which state the insect hibernates.

The moth is not a showy insect, having the fore-wings light brown, variegated with patches of greenish-white, and with many darker brown wavy lines, two of which enclose a small whitish space. The hind-wings of the male are dirty white, with a dusky spot on the inner hind angle; those of the female are sometimes entirely dusky. The body is brownish, with two narrow black bands across the front part of the thorax. The moth spreads nearly an inch and a half.

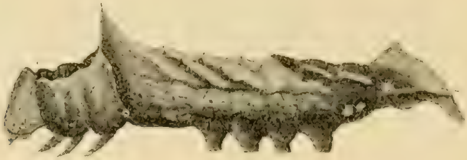


Fig. 112.—Schizura unicornis S. & A. After Packard.

The mimicry of the larva has already been mentioned; that of the moth is equally interesting. It always rests head downwards, with the legs all drawn together, and its wings folded round the body, which is stretched out at an angle of about 45 degrees, the dull gray coloring of the wings with its lichen-green and flesh-colors give the whole a perfect resemblance to a piece of rough bark so that the deception is perfect. Caterpillar and moth are shown in Fig. 112 and in Fig. 113, Plate XIX.

These caterpillars are also general feeders and occur in some numbers on the plum, apple, rose, dogwood, elder, wintergreen, blackberry and raspberry. They can not be called very injurious, as they are not common enough in our State.

THE LONG-HORNED PROMINENT.

(*Schizura ipomeæ* Doubleday).

This insect is also not very common in our State, but as its larva feeds not alone on oak, maple, birch, etc., but also on the blackberry and raspberry, and perhaps on the plum, it is best to mention what is known about it. The caterpillars vary considerably, but usually they are green, speckled with purple. There is also a faint sub-stigmatal sulphur-yellow line, most distinct on the thoracic joints, and a broad pale sub-dorsal line between which the dorsum is pale lilaceous, but thickly mottled with rich purple-brown and ferruginous, leaving a narrow dorsal line distinctly marked. Two elevated ferruginous warts occur on top of joints 4 and 11. The head is large, dark green, with a distinct lateral black and white stripe. The caterpillar differs from that of *unicornis* chiefly by the spine on the front abdominal segment, which is almost three times as large and high and which ends in a deep fork, each tine of which bears a stiff truncated spine. When full grown the caterpillar makes an earthen cocoon, regular oval in shape, covered with sand on the outside. Like all members of the Prominents the larva remains a long time unchanged inside this cocoon, which is one reason why in captivity the adult insects are so difficult to rear.

"The moth is purplish-gray, tinged with sea-green at base and along costa of the fore-wings; frequently with a buff-colored apical patch in the male. Discal spot black, linear, and followed by a blackish shade. Transverse lines faint, blackish, wavy, the outer lines succeeded by a reddish-brown shade. A series of subterminal dashes, and a few white marks. Hind-wings whitish in the male, dark-gray in the female. Expanse 30 mm." Both moth and caterpillar are illustrated in Figs. 114 and 115, Plate XIX.

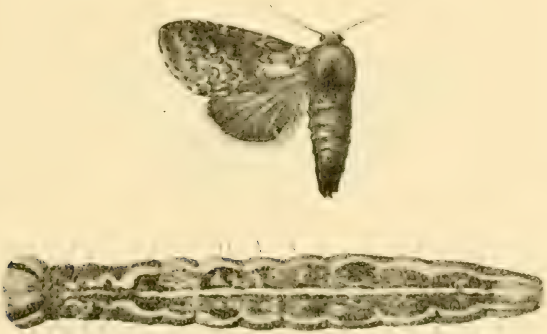
Two other Prominents occur in Minnesota, and sometimes they are found in large numbers, showing that their larvæ, which feed on the leaves of the apple, hawthorn, walnut, basswood, maple and oak, are more or less injurious, though they never have been numerous enough to cause serious injury. The descriptions given by Beutenmueller, in his "*Descriptive Catalogue* of the *Bombycine Moths, etc.*," are given below.

Heterocampa manteo Doubl.

"MOTH.—Fore-wings ash-gray, varying from light to dark gray, with three scalloped, darker, transverse lines, the scallops filled with light gray. A large discal pale-gray spot containing two small black dots; costa before apex with short black dashes. Terminal edge notched with black dots. Hind-wings uniform mouse color, fringes paler. Expanse, 40-50 mm.

"CATERPILLAR.—Head dull opaque umber, with a broad darker brown line edged with white on each side meeting the vertex. Body green with a broad subdorsal and two narrow yellow lines. The sides of the first three segments dotted with reddish pink, and there is a reddish streak on the outside of the anal legs. The subdorsal lines diverge on the first segment, and on the next two segments are edged within with pinkish red lines. The space between the dorsal lines is more or less filled with pinkish-red, and with a narrow yellow line along the back, beginning on the fourth segment. Body elongate, with slight traces of a hump on the last segment, otherwise smooth. Length, 35 mm. Double brooded and not common. The caterpillar is subject to variation, especially in the red markings along the back; sometimes the space between the subdorsal stripes is filled in solidly with deep red, and only interrupted by the yellow dorsal line. It spins a rude cocoon on the ground or under the surface."

The moth and caterpillar are shown in Figs. 116 and 117.



Figs. 116 and 117.—*Heterocampa manteo* Doubl. Moth and Caterpillar. After Packard.

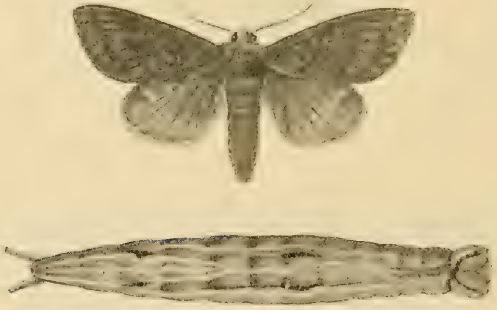
Heterocampa guttivitta Walker.

"Fore-wings whitish-gray, with darker shades; the markings are like those of *H. biundata*, but the subterminal row of spots is straight, and not bent as in the latter species; hind-wings gray. Expanse, 40–50 mm.

Caterpillar:—Head large with a short, lateral four-colored stripe of black, white and pink with the outside yellowish. Body green, finely speckled with dark red brown along the sides. Dorsal line snow white fading into yellowish on the sides, where there is a series of fine dark red black dots; the line is widest on the fifth and sixth segments and at the sature of the seventh and eight segments connects by a narrow neck with the posterior division of the band, which contains a whitish line in the middle, bearing reddish dots on each side. Sides of the tenth to the twelfth segments white, including the upper part of the anal legs, which are marked with a red line. Thoracic feet green, with a black dot in the middle. Length, 35 mm.

Not common and possibly double brooded, the very young caterpillar is reddish brown with nine pairs of long horns like the antlers of a deer. The first pair are much longer than the rest, each with four very long branches."

The moth and caterpillar are shown in Figs. 118 and 119.



Figs. 118 and 119.—*Heterocampa guttivitta* Walk. Moth and Caterpillar. After Packard.

THE FORKED-TAIL CATERPILLAR.

(*Cerura borealis* Bdv.).

There are few caterpillars that are more odd and peculiar in form, posture and motion, than those of the genus Cerura. Their body is naked, short and thick, tapers behind, and ends with a forked kind of tail, which is held upwards at an obtuse angle with the rest of the body. This forked tail, which takes the place of the hindmost pair of legs, is not used in creeping, but is used as an organ of defense. It consists of two movable hollow tubes, within each of which is concealed a long orange-colored thread or flagellum, which the insect can push out and draw in at will. If the caterpillar is disturbed it suddenly erects and separates the two tubes, and pushes out the brightly colored whip-like threads, which, as they lash any intruder, give off at the same time a peculiar odor, no doubt offensive to the same. The caterpillar of *borealis* feeds upon the wild cherry and other allied plants. Its head is reddish-brown. The first very broad segment is square in front on the sides, and ends in a low projection, which looks somewhat like the hood of a monk. The body is pale yellowish-green, with a dorsal median reddish-brown band, beginning at each angle on the first segment, and narrowing on the second and third segments, it begins to widen again on the fourth, becoming widest on the seventh, and extending down each side near the base of the abdominal legs; it contracts and becomes narrowest on the end of the tenth segment, and widens a little on the last. The red patch is sometimes more or less interrupted by the ground color. The anal-plate is triangular, rounded at end; the tails are long, brown, with three pale rings on the outer half. Thoracic feet deep red; abdominal legs pale, tips reddish.

The caterpillars eat a flat depression into wood, over which they spin an oval cocoon, mixed with particles of wood. This cocoon is difficult to detect and very hard.

The moth has a white head and thorax, the latter being bluish-black in the center. The fore-wings are white, with a very broad grayish-black median band with irregular edges, contracting about the middle. Outside is a blackish shade across the wing. The space between the band and shade is white, with two distinct black spots on the costa, followed by two rows each of four small spots. The outer and basal parts of the wings are white, the former with a terminal row of black spots, the latter with a row of four black spots and one spot near the base of the wing. The hind-wings of male are whitish with a small black discal spot, a terminal row of spots and a dusky patch at hind angle; in the female the hind-wings are dusky. Expanse, 38-43 mm.

The curious caterpillar is shown in Fig. 120; the moth in Fig. 121, Plate XIX.

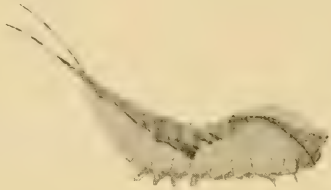


Fig. 120.—*Cerura borealis* Bdv, caterpillar. After Packard.

FAMILY SATURNIIDÆ OR GIANT SILK-WORMS.

Among this family we find the giants of North American moths, some of them expanding four inches and more; in the tropics they are represented by moths that have a spread of wings sometimes fully twelve inches. The larvæ of all spin more or less bulky silken cocoons, and are interesting on that account as the silk could be made of use, being very strong. Formerly the genuine Chinese Silk-worm was classed among these insects.

THE CECROPIA SILK-WORM.

(*Attacus cecropia* Linn.).

The great size and peculiar coloration of this large silk-producing caterpillar (Fig. 122) makes it an object easily recognized. It is nearly four inches long, of a pale limpid-green color, and as thick as a man's thumb. It bears on the third and fourth segments large warts or tubercles of a coral-red color, which resembles small ripe strawberries; the other tubercles on the back of the caterpillar are smaller and yellow, excepting those on the last segments which are blue.

Both the front and hind-wings of the adult (Fig. 123, Plate XIII) are of a rich brown, the anterior pair grayish, shaded with red, the posterior more uniformly brown, and about the middle of each of the wings is a nearly kidney-shaped white spot, shaded more or less with red, and margined with black. A wavy dull-red band crosses each of the wings, edged within with white, the edging wide and distinct on the hind-wings, and more or less faint on the front pair. The outer edges of the wings are of a pale, silky brown in which, on the anterior pair, runs an irregular dull-black line, which on the hind-wings is replaced by a double broken band of the same hue. The fore-wings, next to the shoulders, are dull red, with a curved white and black band, and near their tips is an eye-like spot with a bluish-white crescent. The upper side of the body and the legs are dull red, with a wide band behind the head and the hinder edges of the rings of the abdomen white; the under side of the body is also marked with white.

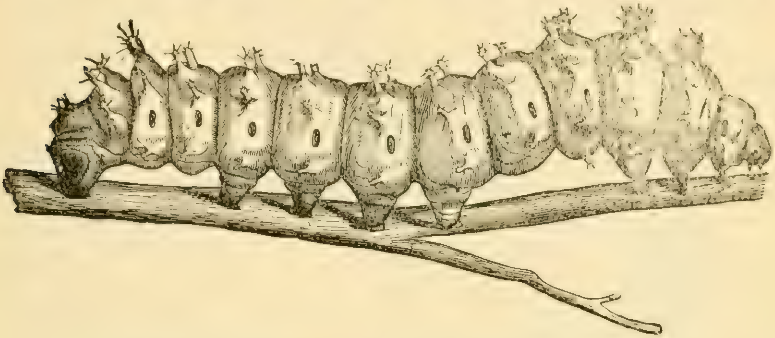


Fig. 122.—*Attacus cecropia* Linn.; caterpillar. After Riley.

The cocoon is about three inches long and an inch or more broad in its widest part, pod-shaped, of a rusty gray or brownish color; it is formed of two layers of silk, the outer one not unlike strong brown paper, and within this a quantity of loose silken fibres covering an inner, oval, closely woven cocoon, containing a large brown pupa. Snugly enclosed within this double wrapper the pupa remains uninjured by the variations of temperature during the winter. Late in May or early in June the pupal case is ruptured by the struggles of its occupant, and the newly born moth begins to work its way out of the cocoon; to lessen the labor a fluid is secreted about the mouth, which softens the fibres; then a tearing, scraping sound is heard, made by the insect working with the claws on its fore-feet, pulling away the softened threads and packing them on each side to make a passage for its body.

The natural enemies of this species are usually sufficient to present an undue increase of these voracious caterpillars, but if for some reasons such enemies are absent the caterpillars become very numerous and destructive. This is especially true in the windbreaks in our open prairies, where they cause sometimes considerable trouble. Orchards and nurseries also suffer from time to time, but as a general rule these insects are not numerous enough to inflict serious injury. Their large size, and their work in defoliating trees and shrubs, soon attract attention, and they can readily be removed by hand-picking. The caterpillars are destroyed by numerous parasitic insects, chief among which are Tachina flies, (Fig. 124, Plate XIV.) the Long tailed Ophion (*Ophion macrurum*), the Cecropia Chalcis-fly (*Smicra mariæ*), Cecropia Cryptus (*Cryptus extrematis*) and others. Birds are also effective in destroying both caterpillars and pupæ; the Hairy Wood-pecker eats the pupæ of a large number of cocoons during the winter. Many others are destroyed by the Blue-Jay, and by our odoriferous friends the Skunks, who find most of the cocoons formed near the ground.

The caterpillars of this moth are very general feeders, and in 1882 in Papilio a list of 49 species of plants belonging to 20 genera was given as their food plants. Since that time many other plants have been found that are to the taste of these voracious feeders, and among them apples, plums, cherries, all kinds of small fruit with the exception of the grape-vine; other cultivated plants also furnish food.

THE POLYPHEMUS SILK-MOTH.

(*Telea polyphemus* Linn.).

The caterpillar (Fig. 125) of this large moth is quite different from that of the *cecropia*, being of a limpid light yellowish-green color, with seven oblique pale yellowish lines on each side of the body; it lacks the prominent tubercles, but has in their place little black wart-like processes which give rise to small and stiff bristles. The segments, which have the spaces between them deeply indented, are each adorned with six wart-like processes or tubercles, which are sometimes tinted with orange; each segment has a small silvery spot on the middle. The head and anterior feet are pale-brown, the spiracles pale-orange, and the terminal segment is bordered by an angular band resembling the letter "V," of a purplish-brown color. When mature the caterpillar spins a cocoon and selects for this purpose the leaves of the tree upon which it fed, by

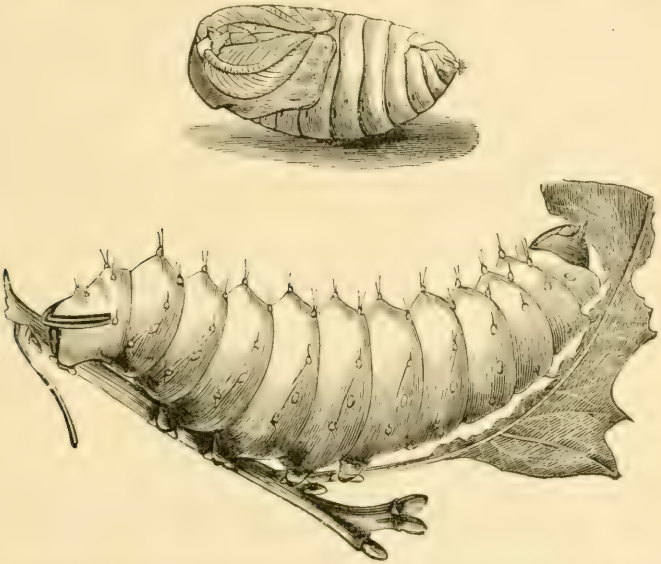


Fig. 125.—*Telea polyphemus* Linn.; caterpillar and pupa. After Riley.

drawing them together and by fastening some of them very firmly to the outside of the cocoon. This latter is oval in shape, of a brownish-white color, and is completely closed, differing in this respect from that of the *cecropia*, which is open at one end. As a general rule the cocoons drop to the ground with the leaves in autumn and remain there.

Late in the spring the moth appears. It is shown in Fig. 126, Plate XIII. Its wings expand from five to six inches, and are of a dull, ochre-yellow color, sometimes of a rich buff, or inclined to a pale-gray or cream color, or they possess a deeper and almost brown color. Towards the base of the wings they are crossed by an irregular pale-white band, margined with red; near the outer margin is a stripe of pale purplish-white, bordered within by one of rich brown. About the middle of each wing is a transparent eye-like spot, divided transversely by a slender line, and encircled by yellow and black rings. On the hind-wings these spots are more eye-like in shape, and are bordered with yellow, with a line of black edged with blue above and the whole set in a frame made of an oval spot of rich dark-brown, the widest portion of it being above the eye-spot, where it is sprinkled also with bluish specks. The front edge of the fore-wings is gray.

The eggs, which measure about one-tenth of an inch in diameter, are slightly convex above and below, the convex portions being whitish, and the sides being brown. Each female deposits upon the under side of leaves from two to three hundred eggs, which hatch in the course of about ten days. While the female is flying about and engaged to deposit these eggs she looks very much like a bat.

This handsome insect has, like the *cecropia*, feathered antennæ in both sexes; those of the males are very broad, almost looking like a third pair of small wings. These antennæ contain an immense number of sense organs. The females, which do not fly before their eggs are fertilized, are quite sluggish until that time. Virgin females can be utilized to "semble," which means that large numbers of males can be attracted to them and can thus be collected and killed.

This insect has also many enemies which usually keep it in check. It is also a very voracious and general feeder, eating the foliage of plum, apple, walnut, butternut, rose, oak and others.

THE LUNA MOTH,

(*Actias luna* Linn.).

There are few insects as beautiful as this moth, which has an expanse of wings of about four and a half inches. The hind-wings, instead of being rounded as is usual with moths, have the anal part extended into a broad tail, curving somewhat outward, an inch and three-quarters beyond the rest of the outer margin. The color of the wings varies in intensity, but they are usually of an even, delicate, bluish-green color, sometimes verging into yellowish, with a little eye-like spot on each wing consisting of a small clear center encircled with lines of red and black. The anterior border of the fore-wings is broadly margined with purple or purplish-brown; the same color occurs upon the collar, feet and legs; the body of the moth is of a soft white. (Fig. 128, Plate XV.)

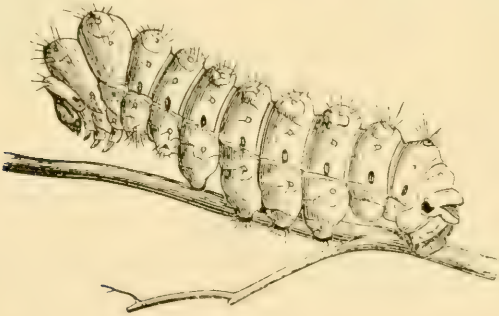


Fig. 127.—*Achias luna* Linn. Caterpillar. After Riley.

The caterpillar (Fig. 127) of this striking moth resembles somewhat that of the *polyphemus*. It is of a clear, pale bluish-green color, with a yellow stripe on each side of the body; the back is crossed between the segments by transverse lines of yellow. On each segment are about six minute, pearl-colored warts, tinged with purple or rosy color; from each arise a few hairs. At the extremity of the body are three brown spots edged with yellow. When full grown it draws together several leaves, fastens them with silken threads, and spins inside this hollow space a cocoon very much resembling that of the preceding species; it falls like it to the ground with the leaves in autumn. The cocoon is quite thin and papery and so compact that it can not well be unwound.

The colors of the moths vary according to the food consumed by the caterpillars. If fed on the foliage of hickory their color is yellowish-green, if on black walnut it is a much more vivid green, and the markings and borders are much darker and more plainly marked. In fact, in some very brightly colored specimens there is a wavy band of purple parallel to the outer borders.

This insect occurs in Minnesota wherever hickories and walnuts grow, but as the caterpillars are also much preyed upon by parasites it is not likely to become a serious pest.

Still another species of native silk-worms has been reported from the state, but must be very uncommon, at least no specimens have been seen by the writer. It is the Prometheus Moth (*Callosamia promethea* Drury). The sexes of this moth differ greatly, both in shape of wings, in color, and in the pattern of their marking.

THE IO EMPEROR MOTH.

(*Hyperchiria Io* Linn.).

This is also a very beautiful insect (Fig. 129, Plate XVI), but it is not as common as the other silk-producing species. The sexes vary very greatly, both in size and color. The smaller male is deep yellow, with rather faint purplish-brown markings; on the fore-wings are two oblique wavy lines near the outer margin, a zig-zag line near the base, and other blackish dots and markings. The hind-wings are of a deeper ochre-yellow, and are shaded with purple next the body; within the hind margin is a curved purplish band, and inside this a smaller and darker one, while in the middle of each hind-wing is a large, round and blue eyes pot, with a broad black border and a central white dash. The antennæ of the male are beautifully feathered; the wings measure, when expanded, about two and a half inches across. In the female the wings are purplish-brown, the transverse lines gray and much more prominent, and there is a somewhat dusky, pale-margined, nearly kidney-shaped discal spot; the hind-wings are very similar to those of the male; the thorax and legs are purplish-brown, the abdomen ochre-yellow, with a darker edging on each ring.

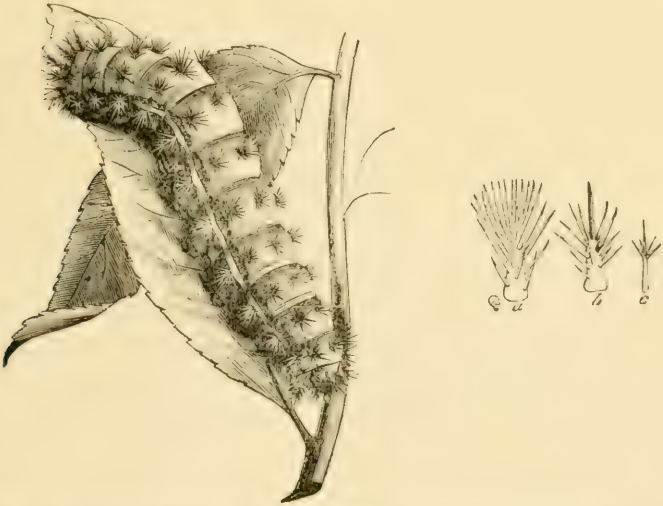


Fig. 130.—*Hyperchiria Io Linn.;* caterpillar; *a, b, c,* branching spines, enlarged. After Riley.

The female deposits her eggs in clusters of twenty or thirty. They are about one-sixteenth of an inch long, top-shaped, of a creamy-white color, with a yellowish spot above. When young the dark-colored caterpillars produced from one cluster of eggs are gregarious, following each other in regular order, but as they grow older they scatter, each shifting for itself. The caterpillar (Fig. 130) reaches its full size during August, when it measures two inches and a half in length. It is now of a delicate pale green color, paler and whitish along the back, with a broad brown stripe edged with white and reddish lilac on each side; the breathing-pores are yellow, ringed with brown. The body is covered with clusters of green and branching spines, tipped with black, which arise from small warts, of which there are a number on each segment. These spines are very sharp and possess strong urticating properties, so if the insect is handled carelessly the points of the spines enter the skin, and breaking off fill the wound with an acid, which can produce on the more tender portions of the skin a considerable irritation accompanied by redness and raised white blotches, very similar to those caused by the common stinging nettle. The irritation is, however, not so great as if produced by the spines of the larvæ of some of the slug-worms. As soon as mature the caterpillar descends to the ground, where it spins a thin, irregular and somewhat parchment-like cocoon made of tough, gummy and brown silk, among and below dead leaves and other rubbish. The enclosed pupa is short and thick, pale-brown, and is ornamented with a few reddish bristles on the abdominal joints and a tuft of the same at the end.

These stinging caterpillars are also very general feeders, being found on a great variety of plants, among them plum, apple, currant, thorn, corn, clover, elm, oak, willow and others.

If this insect ever becomes numerous it can easily be subdued by hand-picking, providing the necessary caution is taken to guard against its poisonous spines, which will, however, not penetrate through thick gloves. A large number of parasites are not afraid of this well-armed caterpillar and usually keep it in check.

FAMILY HEMILEUCIDÆ OR HEMILEUCIDS.

This small family contains but a few rather large and conspicuously marked insects. The antennæ are broadly pectinated in the males and narrowly so or nearly serrate in the females. There is only a single pair of teeth to each segment of the antennæ. The thorax and abdomen are usually thickly clothed with long wooly hair. But one species occurs in Minnesota.

THE BUCK MOTH OR MAIA-MOTH.

(*Hemileuca maia* Drury).

This is still another caterpillar which is much more poisonous than any of those already described. It is very common in Minnesota, and feeds on the wild cherry and apple, but chiefly on the red oak and willows, where it can cause considerable damage, as it is a most voracious feeder. The caterpillar is brownish-black, with six spined tubercles on each segment, except on the eleventh, where there is only one dorsal tubercle; an additional one is found on segments one to five, and also on segments ten to twelve. The spines on these tubercles are more or less branched; some are truncate at the tip and bear bristles. Those on the back are rusty-yellow, tipped with black, with a few wholly black in the center of each branch. The other branched spines are black with the blunt ends white, and the spinules arising from them dusky. The breathing-pores are pale and narrowly oval. The underside of the caterpillar is yellowish along the middle; the head is light-reddish-brown; the thoracic legs are also light brown, but the prolegs are lighter, inclining to Venetian red. When full grown the caterpillar measures a little over two inches in length. Fig. 131 shows the caterpillar, and Fig. 132, Plate VIII, the moth.

The sting of these caterpillars is really quite severe, and it is not easy to handle them with impunity. The insects themselves lack the power of stinging us, and it is simple carelessness on our part if we are injured at all. The effect of these stings is violent pain, a reddening of the punctured parts, and the early appearance of raised whitish blotches, followed later by purplish spots, which do not disappear for several days.

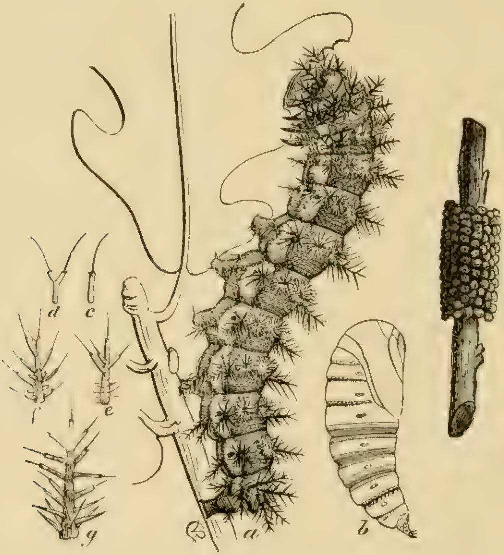


Fig. 131.—*Hemileuca maia* Drury; eggs; *a*, caterpillar; *b*, pupa; *c*, *d*, *e*, *f*, *g*, spines. From Div. of Entomology, Dep. of Agriculture.

When mature all the caterpillars, which are gregarious throughout their existence, enter the ground, and there in a simple oval cell, each one sheds its prickly skin and assumes the pupal state. The pupa is of a deep brownish-black color, heavy, rounded anteriorly, and minutely roughened, except the sutures of legs and wing-sheaths, where it is smooth and polished. The abdomen ends in a triangular, flattened and ventrally concave tubercle, which is topped with a few curled, blunt, and rufous bristles.

The moths, which fly here in Minnesota late in September and the first part of October, differ in habits from those of most other genuine moths by flying in mid-day. They are modest-looking but truly elegant insects. Their wings are so lightly covered with scales that they are semi-transparent, and look like delicate black crape. The bands across them are creamy-white, and broadest on the hind-wings. These bands vary greatly in width, and some are almost obsolete, while in other cases they are very broad. The male differs from the female in having broader black antennæ and a smaller abdomen, tipped with a large tuft of brick-red hair. Its color is cream-white, and the black hairs of the body are more or less sprinkled with hairs of the same pale color. The female has the lower side of the antennæ, the hair on the thighs, and two small tufts behind the thorax of a brick-red color. She deposits her eggs (See Fig. 131) in naked belts of from 100 to 200 eggs; these are only fastened together by a little glue and are not deposited in perfect order. Each egg is obovate, about 0.05 inch long, compressed at the sides and apex, and of a dirty yellowish color.

There are some very curious points in the life history of this moth. The caterpillars, all born at the same time, from eggs deposited by one mother, feed side by side upon the same plant until mature when all enter the ground at about the same time and transform to pupæ. Yet out of 200 pupæ thus formed at the same time early in July only 117 moths issued in the same year, while the rest remained in the ground fully a year longer when most of them issued.

FAMILY CERATOCAMPIDÆ OR ROYAL MOTHS.

This is a small family of fairly large or very large moths, the caterpillars of which are usually furnished with horns, spines or similar processes. The moths are sometimes contrastingly colored, and distinguished by having the antennæ in the male feathered for only a portion of the distance.

As a general rule these insects are not injurious to our fruit-trees, but infest other trees, such as oaks and maples. They not infrequently become so numerous and destructive that but few leaves are left on the oak trees covering many square miles and one can not step upon the ground under the trees without stepping upon some of these hungry worms. One species, however, is found not alone on the oak, but occurs also upon the raspberry and blackberry. It is the Orange striped Oak-worm (*Anisota senatoria* Hub.). The caterpillars have a jet-black head; the body is dull-black, with four dull-orange stripes along each side, and a trace of a fifth stripe along the base of the legs; all the stripes run to the end of the eleventh segment; the last segment is black. The under side is marked with a broad yellow stripe along the middle. On each side of the second segment is a slender, long, slightly curved horn, and along each side of the body three rows of short spines. The caterpillars, of which we have only one annual brood, measure 45 mm. in length. A caterpillar is shown with other oak feeding caterpillars in Fig. 134.

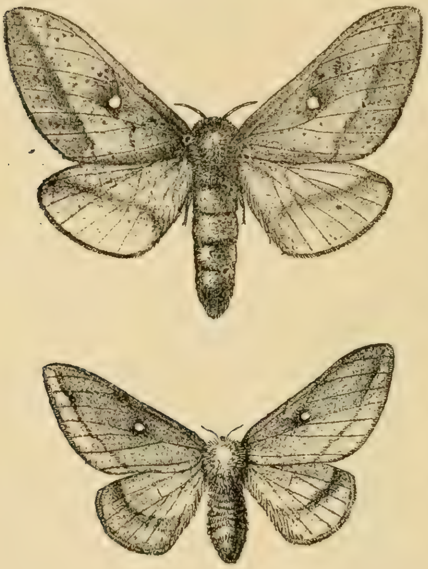


Fig. 133.—*Anisota senatoria* Hub.; male below, female above. Original.

The sexes of this moth vary greatly. The male has ochreous-brown wings with a purplish tinge; the fore-wings are semi-transparent in the middle. There is a conspicuous white, round discal spot and a dark oblique line, from a little before the apex across the wing, parallel with the

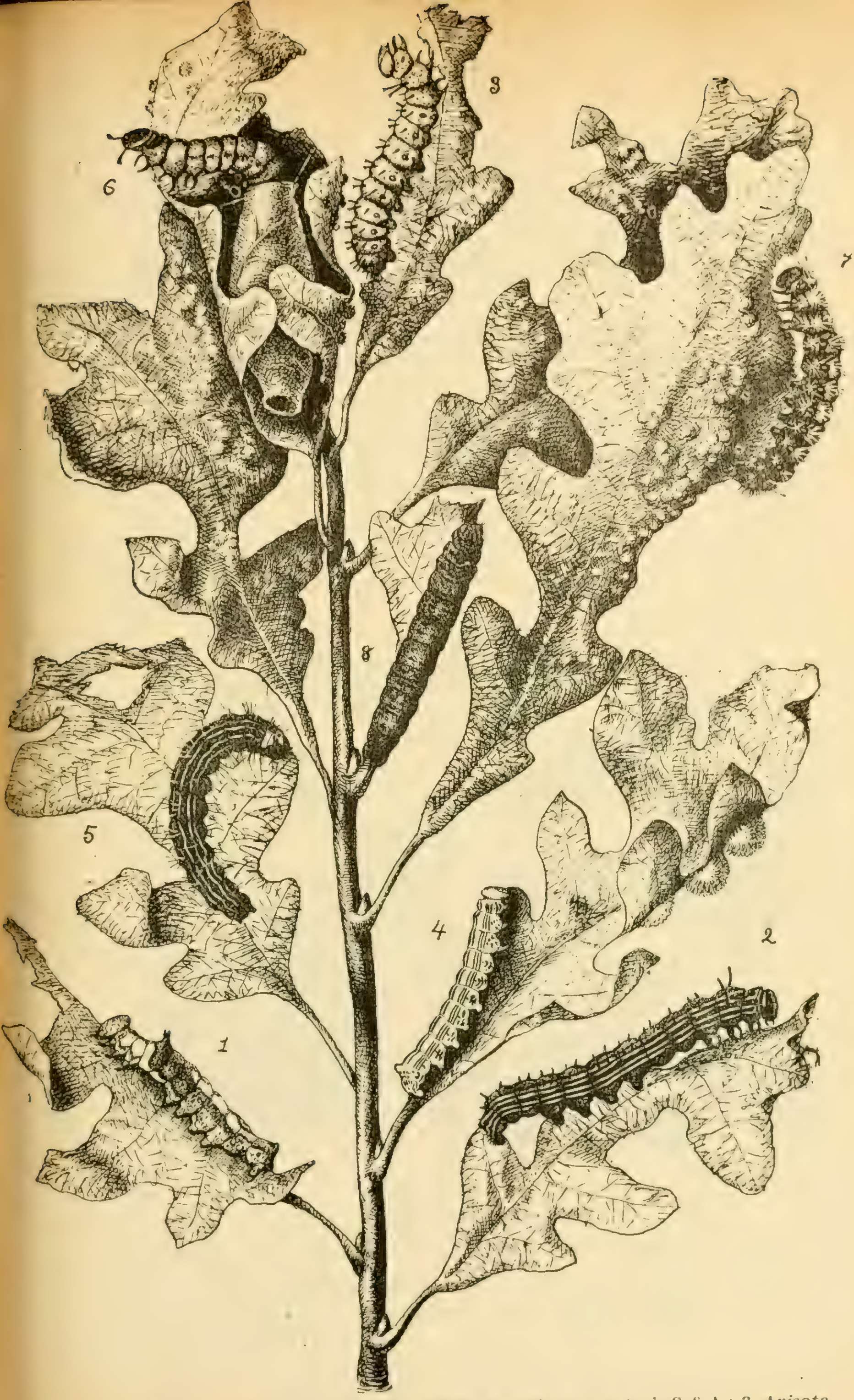


Fig. 134.—1, *Janassa lignicolor* Walk.; 2, *Anisota senatoria* S. & A.; 3, *Anisota virginiensis* Dru.; 4, *Edema albifrons* S. & A; 5, *Datana ministra* Dru.; 6, *Perophora melsheimeri*, Harr.; 7, *Acronycta impressa* Walk.; 8, *Gastropacha americana* Harr Original.

outer margin. The hind-wings are opaque. The female is very much paler in color; it expands from 45-60 mm., the male from 30-38 mm. Both sexes are illustrated in Fig. 133.

FAMILY BOMBYCIDÆ OR TRUE SILK-WORMS.

The Genuine Silk worm (*Bombyx mori* Linn.) belongs here. It is not a native of the United States, but is frequently bred in this country either for its silk or for curiosity. The moth, which in course of time has become dwarfed to such an extent as to be unable to fly, is cream-colored, with two or three more or less distinct brownish-lines across the fore-wings. The head is small; the antennæ are pectinated broadly in both sexes. The silk-worms are usually fed upon the leaves of the mulberry, but not upon those of our Amer-

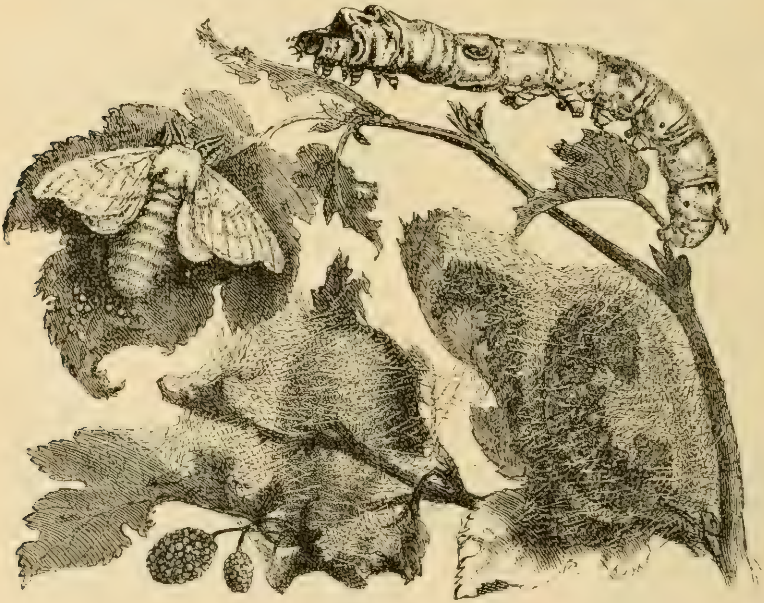


Fig. 135.—*Bombys mori* Linn.

ican species, which are unsuitable. The wilted leaves of the osage orange can also be used. The different states of this important moth are shown in Fig. 135.

FAMILY LASIOCAMPIDÆ OR LASIOCAMPIDS.

This family includes the destructive tent-caterpillars and the lappet moths. The adults are stout-bodied and hairy moths of medium size. The antennæ are pectinated in both sexes, those of the males being usually longest.

TENT-CATERPILLARS.

There are but few insects that are better known to persons interested in fruit and shade trees than the different kinds of tent-caterpillars, which occur throughout the northern regions of the globe, and of which numerous species have been described. All are similar in general appearance and habits. In the United States they are called "Tent-caterpillars," because here one of the most common species is distinguished by its habit of forming a large silken tent for the home and protection of a whole community of worms. All tent-caterpillars, however, spin a large amount of silk, only their tents are not as conspicuous as in the above species. In Europe, but especially in Germany, they are called "Ringelspinner" from the small ring or ringlet-like egg-masses, which the females deposit around a small twig of the tree selected for this purpose. The illustrations show that both popular names are well selected, since they express a habit readily perceived.

In Minnesota we have to deal with two species of tent-caterpillars, which are always common in certain well-defined localities, and sometimes exceedingly so, as for instance in 1898, when in many parts of the State they devoured the foliage of all kinds of trees growing in orchards and forests. Few insects have a more interesting life-history than these caterpillars, and it pays to study it carefully, as by so doing a number of excellent remedies will suggest themselves and can be used to assist us in a war against them.

THE ORCHARD TENT-CATERPILLAR.

(*Clisiocampa americana* Harr.).

The adult insects of this species measure with wings expanded a little more than one and a half inches; they are reddish-brown, and the fore-wings are tinged with gray on the base and middle, and are crossed by two oblique lighter stripes. As they fly only at night they are not often seen; in places, however, where powerful electric lights are used many are attracted and thus can be collected in large num-

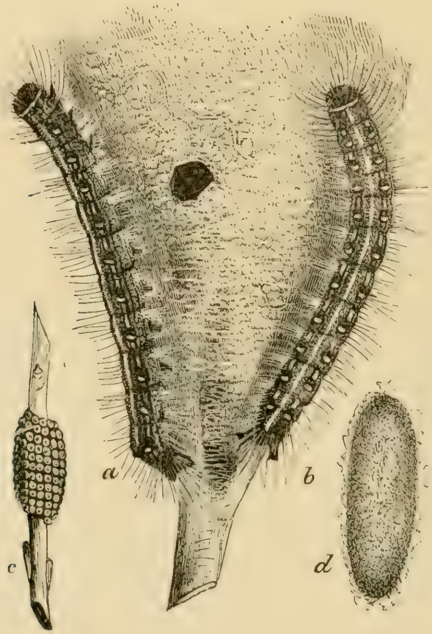


Fig. 136.—*Clisiocampa americana* Harr.; *a*, *b*, mature caterpillars; *c*, egg mass; *d*, cocoon. After Riley.

bers. The moths take no food, hence they can spend all their energy to search for suitable places in which to deposit their eggs. In this manner they sometimes fly a long distance, and especially after a time when the great majority of the nearly grown caterpillars had been killed by a contagious disease; in fact it almost seems as if the moths which had escaped this disease realized the danger and tried to avoid it and to protect their future off-spring against it by migrating to places where the insect, and the disease, had not occurred for some years. Since this disease is very apt to occur whenever the insects have been very numerous for three years in succession in any one locality, we have the reasonable assurance that after that period the insects will disappear from the locality for some time. But as some of the healthy moths escape they start colonies in new regions and as the resulting caterpillars are healthy, they soon increase very rapidly until they are again killed off by the same fatal disease. All attempts to breed and multiply this useful disease by artificial means have failed thus far, but no doubt means will be found in future to utilize it against these destructive caterpillars. In 1898 the disease appeared in a small grove of trees, and the writer took numerous diseased caterpillars to other groves infested with healthy worms. Still other diseased worms were sent long distances to forests invaded with tent-caterpillars, and wherever introduced the disease broke out amongst the healthy worms, and soon destroyed the greater majority of them. Many other forests, as badly infested with these worms, showed no sign of this disease, and it would be more than accident if such places had escaped while others had not. There seems to be but little doubt that this disease can be spread artificially in case we can find diseased worms at the proper time. Two breeding cages were prepared which contained the eggs of healthy moths; at least in the places from which the eggs were taken no disease appeared in the following season.

The breeding-cages were kept in different parts of the same building. In one case the caterpillars were fed with leaves moistened with the crushed substance of diseased caterpillars, and soon afterwards the disease showed itself by killing nearly all the caterpillars in that cage; the worms in the second cage were fed on leaves not so prepared and all matured and formed moths. Equally good results were obtained with a disease destroying the worms so injurious to cabbage, and both cases show that under certain conditions much good can be done by gathering diseased caterpillars and by bringing them in contact with healthy ones.

After mating the females deposit their eggs (about 300 in number) in a belt or ring around the twigs of plum, cherry, shadberry, apple or a few other trees. This takes place early in July. These egg-masses are coated with a thick glue which serves as a protection against moisture and, perhaps, against the cold weather of autumn, winter and spring. Very likely this glue is a non-conductor of heat; at all events the eggs do not usually hatch until the following spring, even if kept in warm rooms. These rings of eggs are readily seen at a time when all the foliage has disappeared from the trees, and they should be removed at that time, which is easily done. Fig. 136 shows a ring of eggs; also two adult caterpillars and a cocoon.

About the time that the buds begin to swell in the spring (about the middle of April in Minnesota) the eggs hatch, and the young caterpillars select some fork of a twig where they form a small nest for themselves. By selecting a fork they can utilize the twigs as tent-poles, around which they build a nest with several openings or doors. Here the colony rests, either inside or on the outside of the tent. As long as the caterpillars are still soft and tender they are most frequently found inside their house, and only during the warmer portion of the day do they bask in the sun upon its outside. As the caterpillars grow they add to this tent until it becomes a very bulky affair partly filled with excrement.

and the old skins of the inhabitants. The tents (Fig. 138, Plate XVII), when opened, will be found to contain numerous blackish caterpillars with yellow and bluish spots and covered with very fine grayish hairs, which prevent any moisture from reaching their skins. The illustration shows two of the full grown caterpillars, which are rather pretty insects, if caterpillars can be so called. When hatched they measure about one-tenth of a inch in length; they are blackish and covered with fine gray hairs (Fig. 144, Plate XXIII). They feed on the young and tender leaves, and eating on an average two leaves a day, the young of one pair of moths consume from ten to twelve thousand leaves, and as it is not uncommon to find from six to eight nests on a single tree not less than seventy-five thousand leaves are devoured, a loss which no tree can long endure.

As the caterpillars grow they cast their skins from time to time. In about thirty-five or forty days they have reached their full size; they are about two inches long, with a black head and body, having numerous yellow hairs on the surface. A white stripe marks the middle of the back, and minute white or yellow broken and irregular streaks are found along the sides. Along each side of the back is a row of small transverse pale-blue spots. Fig. 137, Plate XVII, gives an illustration of the larva.

While young the caterpillars are social in their habits. When they leave their tent to feed, which they do twice every day, they move as a regular army, and as they go they spin a continuous thread of silk from a fleshy tube on the lower side of the mouth, which is connected with silk-producing glands in the interior of the body. By means of this thread they find their way back to the tent, which is the product of the combined efforts of all the caterpillars from one ring of eggs. The caterpillars feed only on warm and dry days; during cold and damp weather they remain in the tent. As soon as full grown they leave their home and scatter in all directions, each searching for some protected spot in which to spin its cocoon. When sheltered spots have been found, usually under projecting objects, such as roofs and upper fence-boards, they spin spindle-shaped cocoons of white and almost transparent silk; when finished they fill the spaces between the silken threads with a sulphur-yellow 'substance, which in drying becomes a powder. Inside these cocoons (most beautiful objects) they change to pupæ, from which emerge, in from twenty to twenty-five days, the moths, ready to start another brood for the following year. This caterpillar, although quite numerous in Minnesota, has not created as much alarm as the one described next.

THE FOREST TENT-CATERPILLAR.

(*Clisiocampa distria* Hub.).

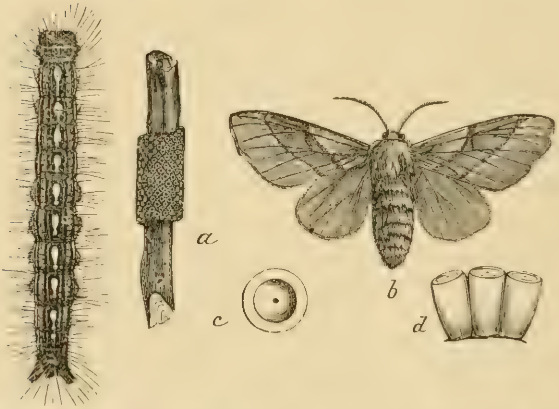
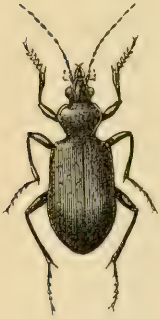


Fig. 139.—*Clisiocampa distria* Hub.; caterpillar; *a*, egg-mass; *b*, moth; *c*, top of enlarged egg; *d*, three enlarged eggs. After Riley.

This caterpillar (Fig. 139) is even more common than the Orchard Tent-caterpillar which it closely resembles. It does not, however, construct a large tent. The caterpillars feed upon the foliage of various species of forest trees, such as oak, ash, maple, etc., but they prefer linden or bass-wood; they are also very injurious to plum, cherry, apple and other fruits. The moth (Fig. 140, Plate XVII), which expands an inch and a half or more, is brownish-yellow. It has on the fore-wings two oblique brown lines enclosing a darker space. The eggs are about one twenty-fifth of an inch long and one-fortieth wide; they are arranged three or four hundred in number in the form of a ring around the twigs of trees. These clusters differ from those of the other tent-caterpillars in being uniform in diameter and cut off squarely at the ends. The individual eggs are white; they are covered with a brown varnish-like substance. The eggs hatch also early in spring, and the young caterpillars have sometimes to wait for some time before the trees furnish any food, but as they are very hardy they have been known to live in cold weather for three weeks without eating. The writer kept them under melting ice for four days without injuring them in the least; in fact, as soon as thawed out they seemed to show increased appetite. But as the buds expand and the young leaves appear the worms make up for lost time. Like the other tent-caterpillars they spin a silken thread wherever they go; they are also gregarious as long as young, but scatter when older. They march in regular order, feed twice a day and when not thus engaged they crowd together, most frequently upon the trunk of a tree (Fig. 141, Plate XIX). In such positions they also undergo their moults, and not infrequently large numbers of their empty skins are found together, held in position and to the tree by numerous threads (Fig. 142, Plate XIX). The caterpillars, when fully grown, are a little smaller than their relatives upon orchard trees. Their general color is pale-blue, tinged with green on their sides, and everywhere sprinkled with black dots or points, while along the middle of the back is a row of white spots, on each side of which is an orange-yellow stripe, below which is another cream-colored one. All these stripes are edged with black. Each segment of the caterpillar has two elevated black points on the back, from which arise a number of coarse black hairs. The back is clothed with whitish hairs; the head is dark blue, freckled with black dots, and clothed with black and fox-colored hairs; the legs are black, clothed with whitish hair. Fig. 143, Plate XX shows these caterpillars.

When mature these caterpillars wander on fences, houses and along roads in search of suitable shelters in which to form their cocoons, which are a little more loosely constructed than those of the other tent caterpillars. After having finished these cocoons they transform in two or three days to reddish-brown pupae densely covered with short, pale yellowish hairs. Two or three weeks later the moths appear which soon afterward deposit their eggs and die.

Tent caterpillars have few enemies and only few parasites are known to attack them. Some carniverous beetles, as the large black ground beetle, *Calosoma frigidum* devour large numbers; the green Calosoma has been reported to even enter the tents to devour these worms. The skunk also eats large numbers of the wandering caterpillars. Our two species of Cuckoos make it a regular business to feed upon these worms which no other birds will eat. This useful bird is shown in Fig. 145.



Calosoma frigidum. Original.

Remedies.—Many methods have been suggested for the destruction of these caterpillars. In case of orchards or smaller trees the most available and economical way to nip the evil in the bud is to remove the cluster of eggs wherever found and to burn them. In the case of small trees this is easily done, as the egg-masses remain on them during all the time when the leaves have dropped, and as the former are easily seen they can as readily be re-

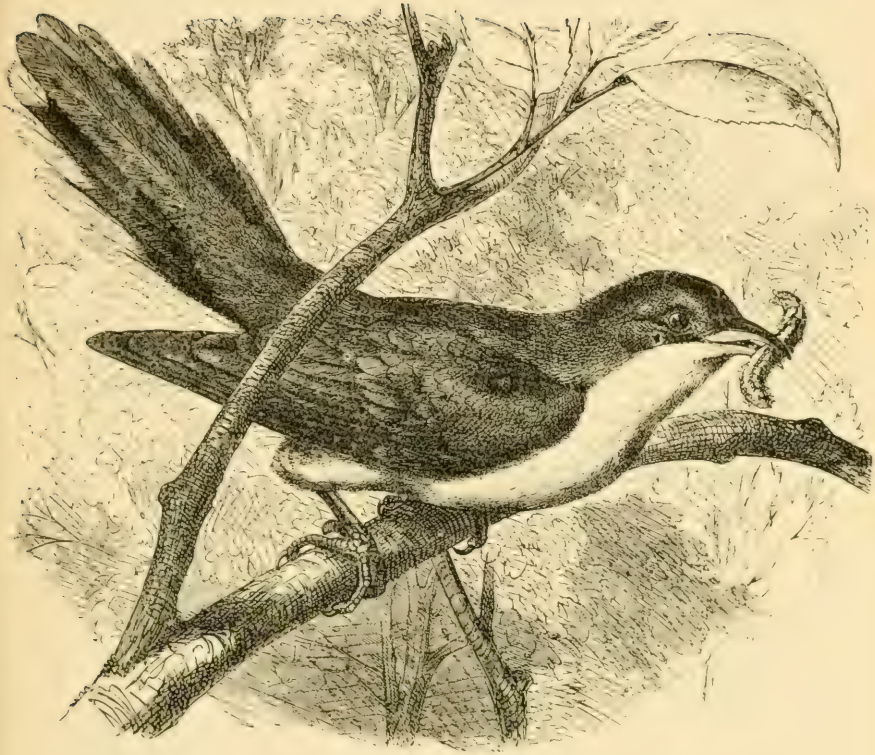


Fig. 145. American Cuckoo or Rain-crow eating hairy caterpillar. From Brehm's Thierleben.

moved. This is at least quite easily done in our orchards, but when it comes to destroying such eggs on forest trees this is not an easy matter, though nearly all egg-masses will be found concentrated upon the twigs of linden. In case of the Orchard Tree tent-caterpillars the white tents made by them are readily detected, and they should be destroyed as soon as possible. This should be done when the caterpillars are at home, i. e. early in the morning or towards evening; during the middle of the forenoon and in the afternoon they are away from their nests and are engaged in feeding. As long as the tents are small and can be reached they and their entire contents should be crushed with the hand protected by a glove or mitten. If they can not be reached in this way the caterpillars can be destroyed by thrusting a rag soaked with kerosene and fastened to a pole, into the tent and by twisting the pole all worms will come in contact with the oil, which will kill them. Burning torches applied when the tent is occupied will also kill the worms but the flame is apt to injure the trees. Of course united action is necessary, for if a single orchard is neglected and permitted to become a breeding-place not alone of the tent-caterpillars but of many other kinds of noxious insects, it is sufficient to stock and restock all neighboring orchards. If all fruit growers in any given region would destroy all the tents on their trees, even for a single season, the work of destroying the caterpillars in the following year would be greatly lessened. In fact it would well pay to offer a small bounty to children for collecting eggs or the small nests still containing the worms. It should be remembered that each ring of eggs, and each small tent, contains from 300 to 400 minute caterpillars which if permitted to grow can cause great injury.

One of the best remedies is the use of Paris-green sprayed upon the foliage of the infested trees. The writer has made numerous experiments with this substance, and has found that the large caterpillars are as readily killed as those just hatched, and that it does not require a large amount of poison to do so. One pound of Paris-green to 100 gallons of water, or one pound to 150 gallons of water, sprayed upon apple trees, had the effect of burning the foliage and injuring the trees very materially. By using one pound of this poison to 200, 250 or even 300 gallons of water all caterpillars were killed in the course of from one to three days. If London-purple is used, one pound to 300 gallons of water will do the work. In both cases it is best to add to the mixture some lime water, which will neutralize any free acid, and in this way prevent injury to the trees to be protected.

THE VALEDDA LAPPET-MOTH.

(*Tolype velleda* Stoll.).

This uncommon insect is sometimes found in its larval state (Fig. 146) feeding upon the foliage of the apple, cherry and plum; it also feeds on the oak, elm, lilac and poplar. The caterpillar is hairy and it hides so well in the cracks of the tree, into which its body fits very tightly, that it is not easily detected; it looks very much like an excrescense of the bark, especially as the side fringes, which border close to the under surface and are composed of spreading tufts of light gray, mingled with black hairs, hide so thoroughly the edges of the caterpillar's body. It has a small and flat head, nearly hidden between two projecting tufts of hair from the second segment; it is bluish-gray and is marked with numerous longitudinal lines; on top of segment three there is a transverse black band, most distinct when the insect is in motion. On top of each segment are two warts, those on segment three in front of the black band are the largest; each of these

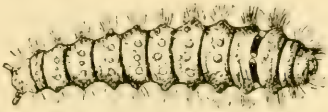


Fig. 146.—*Tolype velleda* Stoll.; caterpillar.

warts gives rise to a few black hairs. There is also a stigmatal row of large warts, from each of which proceeds a cluster of light gray hairs, interspersed with a few black ones. The under side is of a pale red or orange color, with squarish black spots. When full grown it reaches a length of two inches and a half. Late in July it spins a very dense cocoon, about an inch and a half long and half an inch wide, oval, convex above, and flattened on the under side, of a brownish-gray color.

The sexes of this moth, which is found in August and September, vary considerably in size, the male being much smaller, measuring only from an inch and a half to an inch and three-quarters, while the female measures two and three-quarters inches. The fore-wings of this delicate looking moth are gray, crossed by two double, slightly wavy, white lines at the end of the first and second thirds of the length of the wing, and a single line of the same color near the outer margin. The hind-wings have only the outer line. The body is milky-white, with a large, blackish spot on the middle of its back; that part of this spot which is on the thorax is composed of beautiful, glistening and erect scales, while the caudal part of it consists of recumbent hairs. This moth differs from most other moths by having the body covered with long hairs; it is shown in Fig 147, Plate XXIV.

THE AMERICAN LAPPET-MOTH.

(*Gastropacha americana* Harr.).

This is a very interesting insect and rather common. The moth (Fig. 148 and Fig. 149, Plate XXIV), which occurs in two colors, is quite remarkable on account of the fact that when resting it so closely mimics a dead leaf, that even trained eyes are apt to be misled. Most examples are of a tawny, reddish-brown

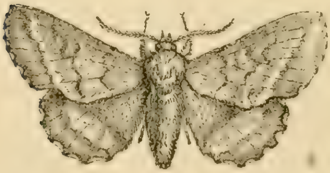


Fig. 148.—*Gastropacha americana* Harr. Original.

color, with the hinder and inner edges of the fore-wings and the outer edges of the hind-wings deeply notched; these notches are edged with white. Both pairs of wings are crossed by a rather broad, interrupted whitish band, which on the fore-wings does not always reach the front margin. In the female the pale bands and dark lines are sometimes wanting, the wings being almost entirely of a red-brown color. The moth measures with expanded wings nearly one inch and three-quarters across.

The white eggs have peculiar black markings and are most beautiful objects under a magnifying glass. They are deposited on the leaves of the apple, cherry and oak late in June. The caterpillar is also very difficult to detect, as it hides during the day on the twigs of trees and is only active at night. It possesses a broad body, convex above and perfectly flat beneath, which, when fully extended, very closely resembles a natural swelling of the bark. It is of an ash-gray color fringed close to the under side on each side with tufts of blackish or gray hairs, springing from projecting tubercles. The caterpillar (Fig. 134) is easily recognized by a bright scarlet and velvety band on the posterior part of the third segment, and by a similar one on the fourth; both of them are only visible when the larva is crawling. There are a number of small tubercles on the segments from which grow tufts of grayish hairs mixed with white ones. The under side of the caterpillar is orange colored, with a central row of square blackish spots. The mature larva measures fully two inches in length. It spins a peculiar gray cocoon which looks very much like a slight swelling of the twig to which it is fastened. The brown pupa remains in it until the month of June of the following year. This insect feeds on apple, poplar and some other plants.

FAMILY COSSIDÆ OR CARPENTER-MOTHS.

Moths of this family are, according to recent writers, very low in the scale of development. The adults, also known as "Goat-moths," from a rank odor peculiar to them, have rather narrow strong and pointed wings and long, spindle-shaped, naked bodies, and some resemble quite closely the hawk-moths in this respect. Their head is small, very much retracted, and the tongue is obsolete, so that the insect is unable to take food. Their nearly naked caterpillars are all wood-borers, living from two to four years in the trunks or roots of trees.

THE GOAT-MOTH.

(*Prionoxystus robiniæ* Peck).

This moth (Fig. 150) is by no means uncommon in Minnesota, being frequently attracted to the electric light. It passes its larval state in such trees as locust, elm, poplar, oak and others, being but rarely found in the trunks of crab-apple. Still there is a possibility that it may become more common, and consequently more destructive, as our apple orchards become more numerous and the trees older.

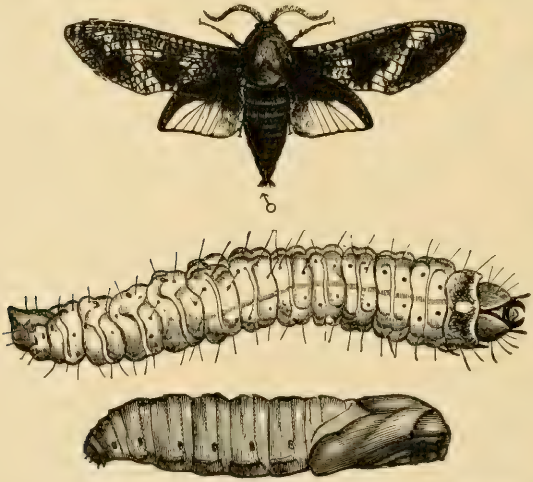


Fig. 150.—*Prionoxystus robiniæ* Peck; male, caterpillar and pupa. From Division of Entomology, Dep. of Agriculture.

The caterpillar lives in the trunk and larger limbs of the infested trees. It has a pale greenish-white body with a tinge of pink or yellow; sometimes a reddish-pink band occurs on the anterior part of each segment, except the third or fourth and the last one. It has a dark colored dorsal line; segments two and three have a brown spot on the top, and on each side of segments four to eleven inclusive are three piliferous spots above the spiracle, arranged in the form of a triangle. These piliferous spots are brown or pink. The under side of the caterpillar is greenish-white, the cervical shield dark or yellowish-brown; the head dark brown, with a somewhat lighter colored face; the jaws are stout, prominent and pitchy. These large and bad smelling worms reach a length of about two inches and a half. When full grown they spin a loose cocoon in the burrow, inside of which they transform to a rather slender, cylindrical pupa, which is furnished with a series of spines around the edges of each segment. When ready to emerge as a moth the pupa twists and wriggles through the bark, and for half its length out into the open, holding fast by the spines on the abdominal segments. The larvæ live in the trunk of trees about three years before coming to maturity. The moth issues late in June or early in July.

The two sexes of the moth differ both in size and in color. The female, which expands from two to two and a half inches, has gray wings marked with irregular black lines and dots. The male, which expands only an inch and a half, has the fore-wings much darker, and the hind-wings are golden or ochre-yellow. There are but few scales upon the wings of these moths.

The eggs are deposited in the crevices of the bark about the first of July, and usually older trees are selected for this purpose. The large eggs are glued so tightly to the surface that they can not be removed without destroying them, and yet they are still so soft when just deposited that they fit any crack, no matter what its shape. Several hundreds of them are deposited by a single female. The young and dark brown caterpillars, with very large heads, bore as soon as hatched in various directions into the trees, but usually in an oblique direction upward or downward, increasing the cavity as they grow larger and lining the same with silk as they go. Remedies are difficult to provide. If the caterpillars are found in destructive numbers in any one locality some valuable trees may be protected by washing the bark about the last of June with soft soap to which is added a little Paris-green or London-purple, which is apt to prevent the moth from depositing eggs upon trees thus protected, and to kill the young larvæ when they leave the eggs and eat their way into the tree.

FAMILY NOCTUIDÆ OR OWLET-MOTHS.

This family of moths is rather uniform, and the species are very much alike. The head is distinct, not sunken into the thorax, as in the Bombycidæ; the palpi are stout, projecting in front of head, but not more than the length of the head; the antennæ are filliform, slightly ciliate, or in the males of some species slightly pectinate. These moths possess a robust body; the thorax has more or less prominent shoulder-tufts, frequently very distinct dorsal tufts, and usually prominent transverse tufts on the prothorax. The abdomen is frequently ornamented with dorsal tufts, and the males possess more or less prominent anal tufts. The fore-wings are comparatively small, narrow, and crossed by a series of more or less marked crenulated or wavy lines, and with two usually darker and two paler spots in the discal part of the wing. The one nearest the base of the wing is called the orbicular; the other and larger one, usually kidney-shaped, is called the reniform spot. The hind-wings are broader, usually without markings; when at rest they are folded and concealed by the fore-wings, which lie like a flat roof over the back. The name "Owlet-moths" is given them because they fly at night, and because their rather large eyes glow with a deep phosphorescence, as if internally on fire. Most of these moths are attracted to light, and many to baits composed of fermenting substances.

The caterpillars, which average from an inch to an inch and a half in length, are cylindrical, tapering somewhat from the middle towards each extremity; their colors are usually obscure, varying from dirty-gray to dirty yellow-brown, generally with feebly marked longitudinal lines.

The pupæ are usually formed in earthen cells under ground, or above the same among leaves and rubbish, tied together by a few silken threads.

As a class these caterpillars are injurious to vegetation, and they are frequently called "Cut-worms," because some of them have the habit of cutting off the tender leaves of plants early in spring. Most of them are injurious to agriculture, and not a few of them cause considerable losses to horticulture.

THE INSCRIBED THYATIRA.

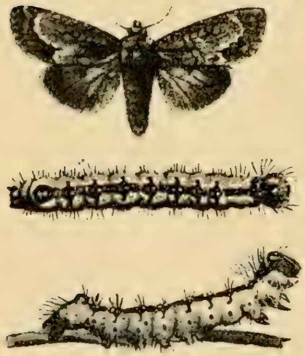
(*Thyatira scripta* Gosse).

This uncommon moth has been repeatedly taken in St. Anthony Park and in Duluth. The caterpillar feeds on blackberry and raspberry; it is of a rich yellowish-brown, sometimes nearly black color, with a distinct black dorsal line. The sides are yellowish with blackish marks and dashes. The upper surface is darker than the rest of the body; the prominent head is yellow, mottled with dark brown. The caterpillar, when at rest, has the anterior and posterior portions of the body elevated, or bent in such a manner that the head rests upon the posterior segments. It is not readily detected as it conceals itself in a shelter formed by bending over the edge of a leaf; it pupates in moss or similar material.

The moth is very pretty, of a pinkish-gray color, and marked in a very peculiar manner with whitish lines and blackish spots, as shown in the illustration, Fig. 151, Plate XVI.

THE GRAY DAGGER-MOTH.

(*Acronycta occidentalis* G. & R.).



Figs. 152 and 153.—*Acronycta occidentalis* S. & R.; moth and caterpillar.

There are a large number of "Dagger-moths," so called from the fact that they have on their fore-wings a number of short, black streaks crossing the transverse lines in such a way that the marks have a remote resemblance to a dagger, or to the Greek letter *psi*, placed sideways. The above species is of a pale silvery-gray color. The fore-wings are pale gray, with various black lines and markings, the principal one being situated in about the middle resembling an irregular cross; a second smaller and similar mark is found between this and the tip of the wing; a black line starts from the base of the wing and extends to near the middle. The hind-wings are darker and glossy gray. Both pairs of wings are fringed with white, with an inner border of black spots. The moths measure with expanded wings nearly two inches across.

The caterpillars of this insect feed upon the leaves of the plum, elm, birch, cherry and apple, reaching their full size about the middle of July. Their large heads are flat in front and are black with yellowish dots on the sides. Their body is bluish-gray above, with a wide slate-colored band on the back, in which is found a central orange-colored line, extending from the second to the fifth segment. Beyond this, to the eleventh, each segment is ornamented with a group of spots, forming a dorsal band; two of these spots are orange, one in front and one behind, and one is of a greenish metallic hue; each group of spots is surrounded by a circular patch of velvety black. Two cream-colored stripes are found on the sides; they disappear towards each extremity. The body of these caterpillars is sparingly covered with whitish hairs, more prominent along the sides. A prominent hump on the twelfth segment and the feet are black. The full grown larvæ is about an inch and a half long. It spins a rather slight cocoon in some sheltered spot, in which it transforms to a polished, reddish-brown pupa. It seems as if this moth was double brooded in Minnesota. The moth and caterpillar are shown in Figs. 152 and 153.

This species is not as common as some other members of this genus of moths, and its caterpillars can readily be killed by spraying with any of the arsenical poisons.

THE MOTTLED PLUM-TREE DAGGER-MOTH.

(*Acronycta superans* Guen.).

The caterpillar of this moth feeds also on the leaves of the plum, but occurs also upon the apple, mountain ash and birch; it seems, however, as if the foliage of the shadberry was the favorite food of this insect, and it is not uncommon to see smaller plants entirely denuded on account of its presence. The larvæ are solitary in habits and appear about the middle of June and again late in September. They vary considerably in color, but are usually greenish, with a broad

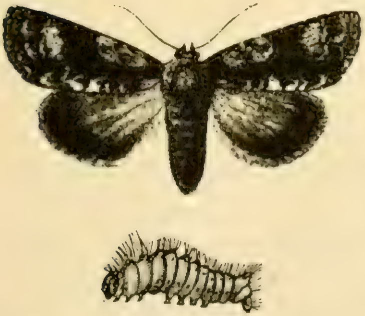


Fig. 154.—*Acronycta Superans* Gu.; moth and larva.

chestnut-colored stripe along the back, margined with yellowish. On each segment are several shining tubercles, from each of which arise one or more blackish hairs; other hairs are found along the sides of the body. The caterpillar is about one inch long, and has the body somewhat compressed, so that it appears higher than is usually the case. It does not assume the usual position at rest as the other members of this genus which curl up somewhat in the shape of a snail. The cocoon is made among dead leaves and is a rather slight affair.

The moth has a gray thorax and abdomen, dotted with black points. The fore-wings are dark-gray, with black or brownish-black markings; the hind-wings are lighter brownish-gray. The moth expands about an inch and a half, it is illustrated in Fig. 154, as well as the caterpillar.

Only in extreme cases are these insects common enough to cause serious injury.

THE RASPBERRY DAGGER-MOTH.

(*Acronycta impressa* Walk.).

The caterpillars of this insect are always common, sometimes very much so, in which case they cause some injuries. They are very general feeders, occurring in Minnesota on the raspberry, blackberry, apple, rose, hazel, and many other plants. Although numerous the caterpillars always feed singly. They are hairy caterpillars, measuring an inch and a quarter in length when in motion, but less than an inch when at rest, as they hump their body in a peculiar manner. The body is thickest between the third and the seventh segment, and tapers a little towards both extremities; it is of a brownish-black color, with a transverse row of paler tubercles on each segment, from which spring clusters of brownish-white or grayish-hairs of varying lengths. Behind the third segment there is a space on the back where the dark color of the body is plainly seen. The head is of a shining black color, the upper portion partly hidden by the overhanging hairs of the first segment. The cocoon which is rather tough, is made of leaves and bits of wood fastened together with silk; inside we find the brown pupa, from which emerges a gray moth, with gray fore-wings, mottled with spots, streaks and dots of darker shades of gray and brown; the hind-wings are of a dull, pale gray color, deepening a little towards the outer margin. The underside of the moth is paler. With expanded wings it measures about an inch and a quarter across

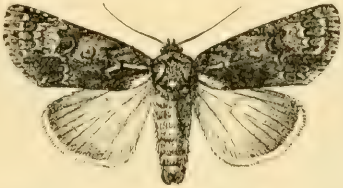


Fig. 155.—*Acronycta impressa* Walk; moth. Original.

These caterpillars are found throughout the summer, as the two generations overlap somewhat. Hand-picking and the use of arsenical poisons will keep it in check. Moth and caterpillar are shown in Fig. 155 and 134.

THE SMEARED DAGGER-MOTH.

(*Acronycta oblinita* S. & A.).

This moth does not show the usual mark of dagger-moths, hence the above rather bad sounding name was given it by some writer.

This conspicuous and very beautiful caterpillar is a hairy insect, very brightly colored and ornamented, and about an inch and a quarter long. Its color is deep velvety black, with a transverse row of tubercles on each segment, those above being bright red and set in a band of the same color, which extends down to each side. Each tubercle gives rise to a tuft of short, stiff hairs which are red on the upper part of the body and yellowish or mixed with yellow below. Upon the back of the larva is a row of bright yellow spots, two or more on each segment; below these and close to the under surface, is a bright yellow-band, deeply indented on each segment. The spiracles are white, and there are a number of whitish dots scattered irregularly over the surface of the body.

The caterpillar of this moth feeds usually upon the willow, but is also very partial to the strawberry and raspberry, and is not infrequently found upon the apple and even the grape. Being often parasitized it is not likely to ever become very destructive, and as it is quite conspicuous it is readily seen. When ready to pupate it constructs a rather coarse cocoon of leaves and silk, inside of which it changes to a dark-brown pupa. We have two annual broods of this insect.

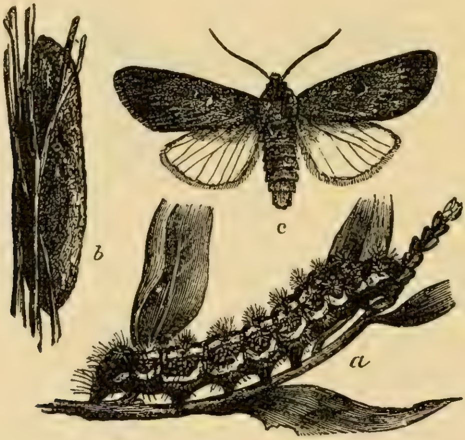


Fig. 156.—*Acronycta oblinita*. S. & A. After Riley.

The moth is not such a gaudy looking insect as its caterpillar, but has a very modest and plain appearance. Its fore-wings are gray, with a row of blackish dots along the hind border. The wing beyond the middle is crossed by a broken, blackish, somewhat indistinct, zigzag line; some darker grayish spots are also found about the middle of the wing. The hind wings are white. Both moth, larva, and cocoon are shown in Fig. 156.

There are a number of other dagger-moths whose larvæ are more or less destructive, being found upon the foliage of fruit trees and upon that of our small fruits. Especially the blackberry and raspberry are to the taste of such worms.

We do not very often find the larvæ of *Acronycta xiliniformis* Gn. upon the foliage of the blackberry, but we do much more frequently on the willow, rose and oak. These caterpillars possess a certain urticating power, which is located in a number of stiff and acute spines springing from warts located on the back. Even the common caterpillar of *Acronycta americana*, so numerous upon such shade trees as maples, etc., although covered apparently with long and soft hairs, can cause considerable irritation upon a soft and tender skin, and the writer has seen the greatly inflamed neck of a boy upon which one of these caterpillars had been pressed by the collar of the vest or coat. This urticating effect seems to be simply a mechanical one, and not one caused by the presence of any special acid.

A. *furcifera*, A. *fragilis*, A. *lithopsila*, A. *funeralis*, A. *tritona*, A. *falcula*, A. *grisea*, A. *luteicoma*, A. *morula*, and A. *hamamelis* all occur in our state and are all known to feed to some extent upon the leaves of fruit-producing plants.

THE PALSIED CATERPILLAR.

(*Harrisimemna trisignata* Walk.).

There are few caterpillars that possess such a peculiar shape, or have such alarming habits as this one, which is frequently found upon the foliage of ash, willow, lilac and the apple. Persons not familiar with such harmless beings as caterpillars are apt to call this one a most hideous looking object, especially if they happen to disturb it ever so slightly; in this case the worm will raise the front part of the body back to the abdominal feet, and thresh it violently from side to side, in fact, its head shakes nearly all the time, like a person with the palsy. To heighten the effect the caterpillar carries a string of cast heads upon some very long and stiff hairs just behind the head. The caterpillar has head and adjoining segment black; segments 3 and 4 yellow with black points; segments 5, 6, and 7 are brown varied with white and 8, 9 and 10 are white, 11, 12 and 13 are brownish-black. The body is very deeply incised between the segments, and the abdominal feet are long, especially the first two pairs. Segments 6 and 12 are much produced dorsally, being very pointed; this, together with the habit of arching the body between the anterior feet and the long abdominal ones, causes it to present a very irregular and jagged outline. The caterpillar eats a hole of the diameter of its body into soft wood, and in it changes to a pupa.

The moth is one of the most distinct and striking ones of all North American noctuids, possessing three round and brown patches on each wing.

The insect is not common enough to cause much injury.

All the noctuid mentioned thus far resemble bombycid caterpillars, being hairy, even possessing pencils and tufts of hairs, and spinning a cocoon. Most of the noctuid caterpillars described hereafter are genuine noctuid caterpillars, and are frequently called "Cut-worms."

Most cut-worms hide in the ground during the day and do not commence to feed until night, when low-growing plants are attacked. Some, however, have developed a climbing tendency, and make their way upon trees and shrubs to eat the young shoots and buds. Whenever such climbing cut-worms are at all numerous in our orchards and fruit-gardens they can cause great destruction, and we have cases on record where they did more damage than any other insect enemy. Being nocturnal they are not often seen, but if the reader will go out some night early in spring, and beat with a stick the twigs of fruit-trees over an inverted umbrella, he will have no trouble in finding more worms than he likes to see. The writer has in this way beaten from a single small apple-tree as many as 100 cut-worms, which accounted for the fact that these trees did not seem to do as well as they ought to. During the day these cut-worms hide in the ground near the tree. As a general rule large numbers of them can be killed by the use of poisoned baits made of bran, Paris-green, water and a little sugar or molasses. These baits are placed near the tree, and will almost invariably attract and kill the majority of such worms. Other baits made of wilted plants and Paris-green are also of great use.

It would take too much space to describe the large number of cut-worms that can be found upon our fruit-producing plants, and only a few will be given; the habits of all are essentially alike.

THE GREASY CUT-WORM.

(*Agrotis ypsilon* Rott.).

This is one of our most abundant cut-worms which attacks all sorts of garden products and other low-growing plants; it is frequently quite destructive to the strawberry beds. When full grown it is about an inch and a half long, dull brown, inclined to black, with paler longitudinal lines, and a faint broken yellowish-white line along the back, and two other indistinct pale lines on each side. The moth is readily recognized by the ypsilon-shaped mark upon the fore-wings, which are brownish-gray

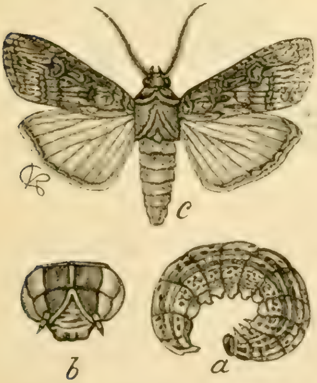


Fig. 157.—*Agrotis ypsilon* Rott. After Riley.

with darker markings; the hind-wings are almost white and semi-transparent, and possess a pearly lustre. Both caterpillar and moth are shown in Fig. 157.

THE VARIEGATED CUT-WORM.

(*Peridroma saucia* Hub.).

We quite often find a large number of eggs, of a pinkish color, round and flattened, deposited side by side on the twigs and leaves of the apple and cherry. These eggs hatch into small dull-yellowish worms with darker spots. The mature caterpillar is of a dull flesh-color, mottled with brown and black, and with elongated velvety-black markings on each side. This is one of the most voracious of all cut-worms, and may be found at almost any time during the season hidden in the ground near some plant. After reaching a length of about two inches it enters the ground to form there an oval and smooth cavity in which it changes to a deep mahogany-brown pupa.

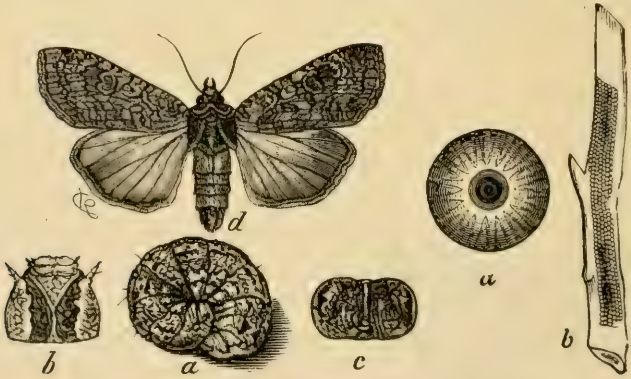


Fig. 158.—*Peridroma saucia* Hub. After Riley.

The moth, which expands about an inch and three quarters across, has grayish-brown fore-wings, marked with brownish-black; the hind-wings are pearly white, shaded towards the margin with pale-brown. The caterpillar, eggs and moth are illustrated in Fig. 158.

THE "W" MARKED CUT-WORM.

(*Noctua clandestina* Harr.).

This caterpillar is also found upon the foliage of the apple and currant. In some seasons it damages seriously the apple-buds, though it usually prefers such plants as corn, cabbage, etc. Both caterpillar and moth are shown in Fig. 159.

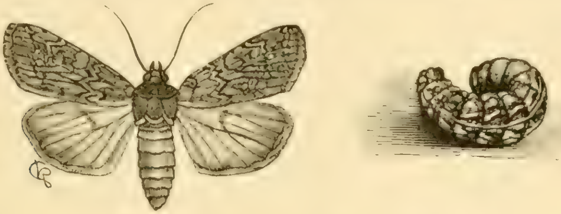


Fig. 159.—*Noctua clandestina* Harr.

THE CLIMBING CUT-WORM.

(*Carneades scandens* Ril.).

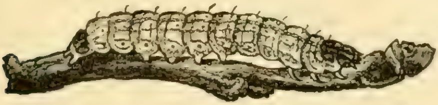


Fig. 160.—*Carneades scandens* Ril., caterpillar.

This cut-worm is a very active climber and causes great losses to the nurseries and orchards. The caterpillar (Fig. 160) is of a light yellowish-gray color, variegated with dull green, with a dark line down the back and fainter lines along the sides; the spiracles are dark, as are the cervical anal-shields. It reaches a length of nearly an inch and a half and when it enters the ground and changes to a brown pupa, from which in time emerges the moth, which is of a light color, the fore-wings being light bluish-gray, with darker markings, and the hind-wings pearly white. This cut-worm is very common in Minnesota, and sometimes almost entirely destroys the very young foliage of our white and over-cup oaks. The moth is shown in Fig. 160, plate VIII.

The Striped Cut-worm (*Feltia jaculifera* Gn.), the Checkered Rustic (*Carneades tessellata* Harr.), the Erratic Army-worm (*Noctua fennica* Tausch), and a number of other cut-worms are only too frequent visitors to our gardens, and are never slow in devouring the foliage of the strawberry and other low-growing plants. They are always very destructive in nurseries, and not seldom enter the greenhouses, where they can cause great havoc amongst tender plants.

The use of poisoned baits against cut-worms has already been given; it can, of course, be employed against all kinds, including the climbing ones. One of the most effective remedies against the latter is to fasten strips of tin around the tree, cut in such a way as to form, when fastened to the trunk, a sort of inverted funnel. Many worms can be collected after dark by jarring the trees over sheets spread on the ground. The writer uses with very good results a large inverted umbrella, the inside of which is lined with some material like that used in the Turkish or bath-towels; this absorbent material is soaked with kerosene, and all insects that drop in the umbrella must come in contact with the oil and are doomed to die. In this manner large numbers of various kinds of insects can be beaten from the trees into the inverted umbrella and then destroyed. If very many trees have to be protected against the ravages of these and allied in-

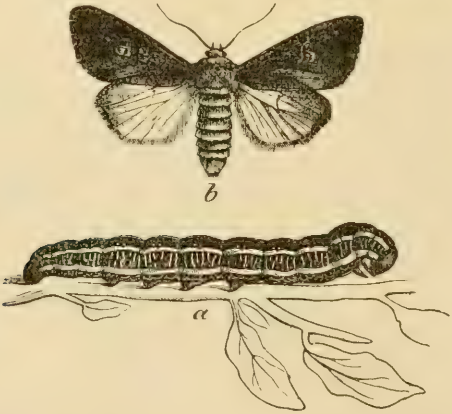


Fig. 161.—*Mamestra picta* Harr. From Div. of Entomology, Dep. of Agriculture.

sects it is of course best to spray them with Paris-green or London-purple, in the proportion of a teaspoonful to a pailful of water, to which should be added some lime-water to neutralize any free acid. In Germany the foresters protect trees by the use of "Raupenleim" or dendrolene; this is a sticky material painted in a ring or band around the trunk of the tree and which prevents the worms from ascending. A wide layer of fluffy cotton-batting, tied at the bottom and folded over to form a cone, is a good substitute for the Raupenleim, which can, however, now be bought in the United States.

There are other genera of cut-worms which are injurious to fruit and fruit trees. *Mamestra confusa* Hub. has been found feeding upon the foliage of apples; so has *M. assimilis* Morr., and even *M. picta* Harr., the Common Zebra-caterpillar of the Cabbage (Fig. 161) is not averse to eating apple leaves.

THE GLASSY CUT-WORM.

(*Hadena devastatrix* Brace).

This insect belongs to another genus of cut-worms. The glassy-looking caterpillar is of a shining pale-greenish color, with a brownish-red head and a dark brown and horny cervical-shield. It has on each ring a number of shining dots, from which arise single hairs. The ashen-gray moth is marked with black and white spots, streaks and dots; the hind-wings are pale and brownish-gray.

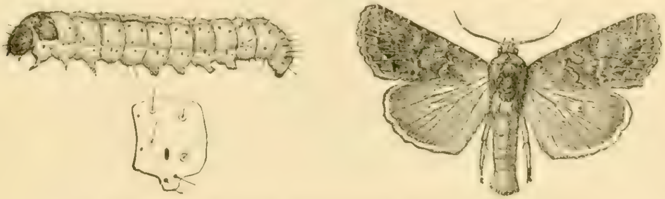


Fig. 162.—*Hadena devastatrix* Brace. After Riley.

These caterpillars are very destructive to the strawberry, as they not simply eat the leaves but cut through the base of the plant, leaving it to wilt. It is not easy to destroy this insect, although the free use of arsenical poisons will have some good effect. All plants that are seen to wilt suddenly should be closely investigated, and with a little attention the culprit will be found in the ground within a few inches of the infested plant. It is illustrated in Fig. 162.

THE FALL ARMY-WORM.

(*Laphygma frugiperda* Guen.).

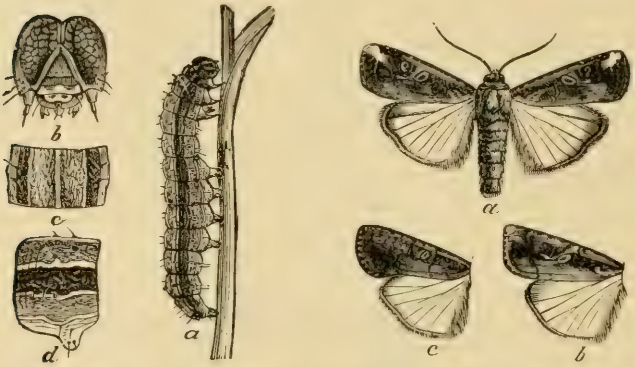


Fig. 163.—*Laphygma frugiperda* Guen. After Riley.

This insect has been repeatedly found in its larval state upon the foliage of the apple tree, though its usual food-plants are grains and grasses; it seems to be, however, a very general feeder. The eggs, which are deposited in small clusters, were also found upon the apple, and the young caterpillars which hatched from them were fed with the leaves of that tree, and they seemed to enjoy this food. There is, however, little danger that this species will ever become destructive to our orchards, but it will always be more or less injurious to our small grains. It seems to have many enemies amongst parasitic insects, otherwise the insect would be very much more common than it is. The moth, which varies greatly, and the caterpillar are shown in Fig. 163.

THE CHAMYRIS.

(*Chamyris cerintha* Tr.).

This beautiful moth, shown in Fig. 164, Plate VIII, feeds also as a caterpillar upon the leaves of apple, plum, rose and related plants, but is not common enough to cause much injury.

PYRAMID GRAPE-VINE CATERPILLAR.

(*Amphipyra pyramidoides* Guen.).

This is a very common insect, which gathers in large numbers about baits made of fermenting substances; many of the moths are found also late in the season hiding under loose bark in the woods. Yet notwithstanding that the moth is very common the fine looking caterpillars are not frequently seen, since they either hide during the day or resemble so closely the foliage among which they are feeding or resting that they are not readily detected. But the effect of their hungry mouths is sometimes plainly visible upon the plum, grape-vine, raspberry, strawberry and other cultivated and wild plants. The caterpillar is nearly an inch and

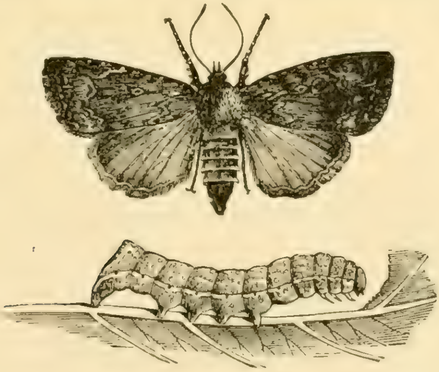


Fig. 165.—*Amphipyra pyramidoides* Gu. After Riley.

a half long, naked, tapering towards the front and thickened behind. It has a small head, whitish-green in color, with the powerful mandibles tipped with black; the body is also whitish-green, a little darker on the sides, with a white stripe on the back, widening behind and slightly broken between the segments. A bright yellow stripe occurs on each side and a second one of the same color, but fainter, half way between this and one on the back, which is more distinct posteriorly and which follows the peculiar prominence on the twelfth segment. The under side of the body is pale-green. As soon as mature the caterpillar descends to the ground, where it draws together some old leaves or similar material, among which it spins a slight cocoon, inside of which it changes to a dark-brown pupa, from which the adult insect escapes the latter part of July or early in August.

The moth is a large and rather heavy insect, measuring across the wings about one and three-quarter inches. The fore-wings, which have a peculiar silky lustre, are dark brown, shaded with paler brown and with dots and wavy lines of dull white: the hind-wings are reddish with a coppery lustre, becoming brown on the outer angle of the front edge of the wing and paler towards the hinder and inner angle. The under surface of the wings is much paler than the upper. The body is dark brown; the rings have a pale border. Both moth and caterpillar are shown in Fig. 165.

THE SILKY PYROPHILA.

(*Pyrophila tragopoginis* Linn.).

Only a single specimen of this interesting moth has been captured, in Rochester, Minn. Its caterpillar feeds upon the grape, and occurs in the Eastern States in sufficient numbers to become a source of annoyance. According to Saunders the caterpillar of this moth is of a yellowish-green color, with a very few fine brownish hairs scattered over the upper surface of its body. It attains its full growth about the middle of June, when it measures an inch and a quarter or more in length. The head is small, green, the jaws tipped with brown; the surface of the body is yellowish-green, a little paler between the joints; there is a white stripe down the back, and two of the same color along each side, the lowest one being most distinct. On each segment there are several small white dots, from each of which arises a single fine hair. The under side is deeper in color than the upper. When mature it changes a little under the surface of the ground to a brown chrysalis, from which the perfect insect escapes in July.

The moth measures, when its wings are spread, about an inch and a quarter across. Its fore-wings are grayish-brown, with a silky lustre, with several pale dots on the front edge, and three short dark streaks near the middle. The hind-wings are paler.

When found to be injurious the caterpillars may be subdued by hand-picking or by the use of arsenical poisons.

THE STALK BORER.

(*Gortyna nitela* Gu.).

In 1898 the caterpillars of this insect were very common and injurious in Minnesota. They not only destroyed much wheat straw in many places, but also caused great injury to the canes of raspberries and blackberries, which they hollowed out so that the infested parts of the plants wilted (Fig. 166, Plate XXIII). They also bored in the stems of the tomato, potato, spinach, aster and others, and even twigs of apple trees did not escape. The worms devoured in some cases the fruit of the strawberry. Besides useful plants, weeds also were destroyed by these voracious feeders.

As long as the caterpillars are still young they are of a livid hue with bright stripes along the body, the one on the side being interrupted towards the head. When the larva has reached its full size it leaves the cane, etc. which it had occupied and descends a little below the surface of the ground, where it transforms to a brown pupa, from which the moth emerges from about the end of August to the middle of September. The moth is of a general mouse-gray color, with a light band on each fore-wing. It, and the caterpillar, is shown in Fig. 167.

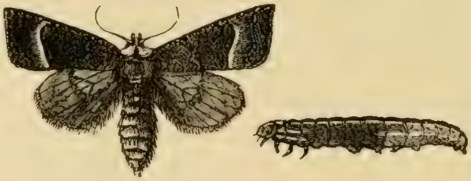


Fig. 167 —*Gortyna nitela* Gu. From Div. of Entomology, Dep. of Agriculture.

There is no known remedy for these insects in the fields; in case the plant infested in an orchard is a valuable one we have to remove the caterpillar with the knife.

THE WHITE-DOTTED APPLE-WORM.

(*Nolaphana malana* Fitch).

This moth (Figs. 168 and 169, Plate VIII.) is fairly common in Minnesota, although its larva was not observed upon the tree it infests until the last season, when late in autumn it was so numerous in some isolated cases as even to cause some injury. The worms were found of nearly all sizes as late as September 15th, eating regular notches in the margins and holes in the middle of the leaves of the apple. Each caterpillar feeds alone, and is well hidden on the under side of the leaf, which is usually somewhat bent and hollow. It is a rather thick, cylindrical, light whitish-green worm,

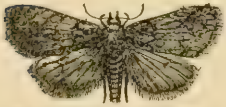


Fig. 168—*Nolaphana malana* Fitch.

with numerous whitish dots. On reaching maturity the larva selects a leaf and drawing together a portion of it with silken threads forms a sort of hollow tube. In this it makes a very slight silky cocoon, inside of which it transforms to a brown chrysalis. We seem to have two annual broods, the last one of which winters in the pupal stage. The caterpillar is shown in Fig. 170, Plate XIX.

The small moth, which expands only three-quarters of an inch or a little more across, has fore-wings of an ashy-gray color, which are whitish towards the margin, crossed by three irregular, black lines, which are faint and indistinct towards the inner edge; near the middle of the wing there is frequently a round and whitish spot with a black dot in the center. The hind-wings are dull whitish, dusky towards the tips. Beneath both wings are of a silvery-whitish hue, sprinkled with blackish dots towards the outer edges.

These caterpillars feed on the cherry, plum, elm, poplar and other trees, but seem to be partial to the apple and shadberry.

THE UNIFORM WHITE-SPOTTED SCOPELOSOMA.

(*Scopelosoma sidus* Gu.).

This is one of our very earliest moths, examples having been caught as early as March 15th. The moths are readily attracted to sugar baits, and come in large numbers until about the middle of April, when they gradually disappear. In captivity they readily deposit yellowish-white eggs, perfectly globular, and ornamented with numerous fine ridges. Before the eggs hatch they change to a light brownish color. The caterpillars have a bright honey-yellow head, and the cervical-shield, which is very prominent, is polished black. The thoracic and first abdominal segments are brownish, the dorsal space is light green or whitish, with the median line and subdorsal stripe white; a brown line above the stigmata and a broad, white, lateral line are also seen. The under side is light green. All the piliferous warts are prominent, black, and bear a short fine hair. As soon as mature, which takes place about the middle of May, the larvæ enter the ground in which they pupate. Some of the moths issue from the last of September to the early part of November, and seek shelter under loose bark and other suitable places; other pupæ remain in the ground until the next spring.

The moths are rather uniformly brown with a few more or less distinct wavy lines of gray or grayish-white. Most of them have in the middle of the fore-wings a perfectly white spot, which is, however, in some cases colored very lightly with brownish. It is shown in Fig. 170½, Plate XXIII.

A number of other species of the genus *Scopelosoma* fly at the same time; they have identical habits and their caterpillars are all very similar. They are very general feeders, and as they hatch in most cases before there are any leaves they attack the leaf-buds of oak, cherry, apple, raspberry and blackberry. If numerous they can cause some damage. A single application of London purple will prevent any further injury.

THE ASH-GRAY PINION.

(*Xylina antennata* Walk.).

The caterpillars of this moth are also very general feeders, but as they have the bad habit of boring into young apples and of eating the foliage of that tree, of the hickory and other trees, it is best to describe them in this place. As far as the habits of this insect are concerned they are very similar to those of the one just given. The moths appear also very late in the year and quite early in the following one, having been captured in large numbers in April. The full grown caterpillar is pale green, with cream-colored spots and a broad, cream-colored lateral band along the sides. The large head is glassy-green with white mottlings at sides and top, and pearly-white lips; the legs are whitish; the prolegs concolorous with the under side of the caterpillar, which is a glaucous-gray. When the caterpillar has reached a length of about one inch and a fourth it is full grown and now enters the ground in which it forms a very thin cocoon of silken threads, inside of which it changes to a mahogany-brown pupa. Fig. 172 shows moth and caterpillar.

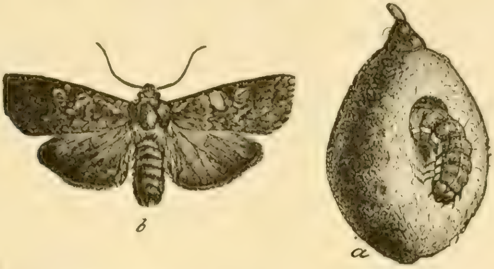


Fig. 172.—*Xylina antennata* Walk. From Div. of Entomology, Dep. of Agriculture.

The moth is of a dull ash-gray color; the fore-wings are variegated with darker gray or grayish-brown. When at rest the wings are folded lengthwise and appear almost parallel and like a flattened roof, giving the insect an elongate appearance.

BETHUNE'S XYLINA.

(*Xylina Bethunei* G. & R.).

This moth is found in large numbers with the preceeding one, and as it feeds in its larval stage upon the same useful plants it is here mentioned. The moth is very different in coloration, though otherwise like *antennata*. The color varies greatly, some moths being almost white, or brownish-white, with slightly darker markings, while others are much darker, with quite dark brown markings, which obscure the lighter ground-color. The under wings also vary in intensity of color, some being almost cream-white, while others are decidedly dusky. A moth is shown in Fig. 173, Plate XXIII.

The life-history of this insect is almost identical with that of *antennata*.

A number of other species of this genus fly at the same time, and as they are sometimes very numerous they must cause some injury. The caterpillars of *X. devia* and of *X. ferralis* have been bred in captivity not alone upon oak but also upon the apple.

THE PLUM-TREE CATACOLA.

(*Catacola ultronia* Hub.).

In the large family of noctuid moths few are better known and more admired than the moths forming the extensive genus *Catacola*. As far as the collector of moths and butterflies is concerned these insects are his pets. The members of this genus are medium or quite large moths, with very bright colored hind-wings, which are banded with black, yellow, red, or white; even the blue color occurs in a German species, where the moths are known by the name of "Ordensbänder." Their fore-wings are mottled with various colors and look like bark. They rest exposed during the day upon the trunks of trees, entirely invisible because they thoroughly blend with their surroundings and having the bright-colored under-wings entirely covered with the upper ones. The moths seem to know how the surface of their fore-wings is marked and colored, since, if disturbed, they fly off very rapidly to some other tree, and circling around it they do not settle unless it offers spots matching these colors.

The caterpillars of the moths under consideration are very curious beings, which resemble those of the lappet-moths already described. The leech-like caterpillar (Fig. 174) is flattened, having the body thick in the middle and tapering towards each end. It is of a grayish-brown color, like the bark upon which it hides while resting. When full grown it is a little longer than an inch and a half, is dull grayish-brown above, with two or four small reddish tubercles on each segment of the body, all encircled by a slight ring of black at their base. On the upper part of the ninth segment is a stout and fleshy horn about one-twelfth of an inch long, pointed, and similar in color to the body, but with an irregular grayish patch on each side. On the twelfth segment there is a low, fleshy ridge, tinted behind with deep reddish-brown; there is also an oblique stripe on this segment of the same color extending forward.

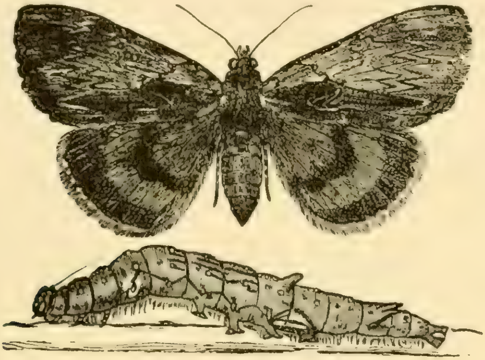


Fig. 174.—*Catacola ultronia* Hub.

Along the sides of the body, and close to the under surface, there is a thick fringe of short, fleshy looking hairs of a delicate pink color. The under side is also pink, deeper in color along the middle, with a central row of nearly round black spots, which are largest from the seventh to the eleventh segment.

These caterpillars are not uncommon; they prefer the foliage of the plum-trees, upon which tree they sometimes occur in large but never in destructive numbers. When the caterpillar has reached its full size towards the end of June it descends to the ground, where under some dead leaves it makes a very flimsy cocoon of silk, inside of which it changes to a brown pupa, which is densely covered with a peculiar bluish flour-like substance that rubs off very readily.

The beautiful moth, shown in Fig. 174 and in Fig. 175, Plate XXIV, has the fore-wings of a rich amber color, darkest on the hind-margin, with a broad diffused ash-colored band along the middle, not extending to the apex, which is brown. Several brown and white zigzag lines cross the wings. The hind-wings, usually so dull colored in Owlet-moths, are deep red, with a wide black band along the outer margin and a narrower one of the same color across the middle.

The moth deposits her eggs, which are well hidden in the cracks of bark, during July and August.

THE APPLE-TREE CATACOLA.

(*Catacola grynea* Cram.).

This is another species found rather abundantly in Minnesota. The moth is not as brightly colored as the one described before, but is also a very fine insect. Its fore-wings are uniformly grayish-brown, marked with zigzag lines of rich brown and gray, and with a number of very dark-brown short streaks on the anterior margin. The under-wings are reddish-yellow, margined with lighter reddish-yellow, and crossed by two wavy black bands. It is shown in Fig. 176, Plate XXIV.

The caterpillar is ashen-brown with a reddish cast. An indistinct light-colored dorsal line and two or three indistinct lateral light-colored stripes distinguish it. On the dorsal space is a row of small prickles, of which those on the posterior part of each segment are the largest. There are three small points on the sides of each segment arranged in the form of a triangle. On the top of segment eight there is a projection, sometimes of a redder color than the body. The under side is light colored, sometimes tinged with red, marked with a row of black spots, one to each segment. The head, bilobed at top, is reddish or grayish-ash, frequently bordered on the top and sides with black. When full grown the caterpillars measure one and a quarter inches in length; it now forms a cocoon among dead leaves.

The two anterior pairs of abdominal legs are much smaller in the caterpillar of this genus of moths than the two posterior pairs, hence they possess a looping gait.

There are other species of *Catacola*, the caterpillars of which occur upon the foliage of fruit trees, but as the life-histories of all are very similar it is not necessary to mention them. At all events they do not occur in sufficient numbers to cause much injury. A much larger species found on apple is *C. paleogama* Gu., on Plate XXIV, Fig. 177.

FAMILY GEOMETRIDÆ OR SPAN-WORMS, LOOPERS OR MEASURING-WORMS.

There is not much difficulty in recognizing these insects. The moths possess slender bodies, small heads, and very broad, frail and thin wings. The hind-wings are usually as much ornamented as the fore-wings, so that the lines of the one pair are often continued across the other. The lower-wings are not hidden at rest, but all four wings are fully extended in most cases, although exceptions occur. The caterpillars lack all save one or at most two pairs of false or abdominal unjointed legs, and in moving they first extend the body to its full length, then bring the posterior end of it close to the front legs, looping the body in the center, then stretch out again and repeat the action. This peculiar motion has given them the names of Span-worms or Measuring-worms, as well as their scientific name *Geo-*

metridæ. Prof. Comstock describes these worms and their very chacteristic actions in this way: "As children we had the dislike for 'worms' that is common to people that are uneducated to the beauties of nature. All larvæ were 'worms,' and we never thought of admiring their beautiful colors, or of watching them build interesting houses, or of keeping them until they spun their silken cocoons. But the measuring-worms were excepted from this dislike. We always found these delicate, greenish or yellowish caterpillars with their looping motion vastly interesting. We allowed them to measure our fingers with their little tickling feet, and we counted each length as a yard. We were always delighted with the way they had of standing on their hind legs, rearing the body up into the air, and moving the head around as if looking at the scenery. And then, if one became frightened in any way, it would drop suddenly, suspended by a silken cord, which it had mysteriously concealed in its mouth; and down it would go, doubling and whirling around and around frantically until it reached the ground."

THE SNOW-WHITE EUGONIA.

(*Ennomos subsignarius* Hbn.).

This is a very common moth, which has long been known as destructive to shade trees, and especially to the elm and linden. But its caterpillar feeds also upon the foliage of the apple, and in the south this insect has been quite destructive from time to time.

The moth is pure white, spreading about an inch and a half across. The sexes differ in the antennæ which are strongly pectinated and toothed in the male and but slightly so in the female. The latter deposits a large number of smooth irregularly ovoid eggs, slightly flattened on the sides, rounded at the bottom, with a depressed top with a whitish rim or edge, which forms a perfect oval ring. Many hundreds of eggs are deposited in rows on the underside of the limbs, frequently near the very tops of the trees.

The dark-brown caterpillar has the large head and terminal segment of a red color.

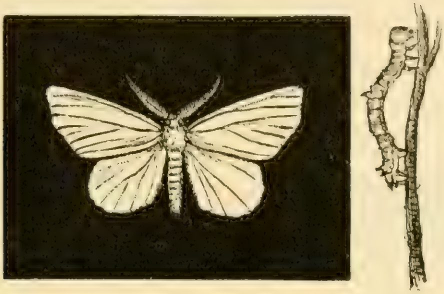


Fig. 178.—*Eugonia subsignaria* Hbn. From Div. of Entomology, Dep. of Agriculture.

Whenever this insect becomes as numerous as it is in other regions, where its caterpillars devour the leaves of almost every kind of tree, bush or shrub, we should spray the infested trees with Paris green or London purple.

The moth and caterpillar are shown in Fig. 178.

THE CURRANT ENDROPIA.

(*Endropia armataria* H. S.).

This is not a common insect, hence not injurious at present, yet it has been found several times in rather large numbers upon the black currant, the leaves of which are eaten by its larvæ. It also eats the foliage of the red currant. We find during July small and nearly black measuring-worms upon the leaves of this plant; the worms are spotted with pale-yellow, and have a series of crescent-shaped spots on their back and a row of raised dark-brown dots along each side, those on the posterior segment being tipped with yellow, while on the last segment there is a fleshy hump or prominence composed of two round tubercles. This caterpillar reaches a length of three-quarters of an inch, when it constructs a slight web, interwoven with bits of dead leaves and other rubbish. Inside this cocoon it changes to a brown pupa which does not produce the winged insect until June of the following year.

The small moth is a rather pretty insect, having the wings, and especially the hind ones, deeply indented. The wings are yellowish-brown, shaded with purple, especially on the hind-wings, and with streaks and dots of a deeper shade of brown. The lower surface of the wings is deep-yellow dotted and streaked with reddish-brown. Two moths are shown in Fig. 179.

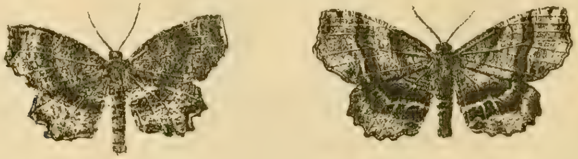


Fig. 179.—*Endropia armataria* H. S.

THE CURRANT ANGERONA.

(*Angerona crocataria* Fab.).

The moth of this insect is quite numerous, and may be frequently seen flying about, especially if we flush it by walking in open woods or wherever the wild currant, gooseberry and strawberry are found in abundance. It is a bright-colored insect, varying greatly in intensity of colors and markings of wings. The usual color is sulphur-yellow, more or less intense, marked with brownish or dusky spots, which are sometimes very numerous, while in other examples they are almost absent. In well-marked examples they form an imperfect band across the wings. The underside of the insect is usually a little deeper in color than the upper one. With expanded wings the moths measure nearly an inch and a half across.

The caterpillar, a little longer than one inch and a half when mature, is a typical spanning—or measuring-worm, which tapers considerably towards the front. It is of a yellowish-green color, with an indistinct whitish line down the back, and a rather broad whitish streak on each side below the spiracles, bordered above with faint purple, which increases in depth of color on the posterior segments and becomes a purple stripe on the last one. The spiracles are white, edged with purple; each segment of the body has the anterior portion swollen and yellowish, and on most of the segments are a few minute black dots.

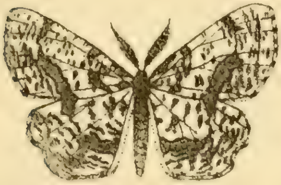


Fig. 180.—*Angerona crocataria* Fab.

The caterpillar forms a slight cocoon inside the space of a leaf, the edges of which have been drawn together for this purpose. The pupa is of a dark olive-green color, with a pale-greenish abdomen and a row of black dots down the back and another one on each side. The imago appears in about a fortnight; it is shown in Fig 180.

Being a general feeder, the insect, though quite common, does not often occur in sufficient numbers on cultivated plants to become destructive. Yet the writer has seen cases where large patches of currants had lost their entire foliage on account of these worms. In fact we can never say with any assurance that an insect of this kind will not most unexpectedly and suddenly multiply to such an extent that it becomes a veritable pest. Another geometer, usually very uncommon, in fact almost unknown, became so destructive in 1898 as to defoliate the wild gooseberry plants over many square miles. It is the *Diastictis* (*Thamnonoma*) *flavicaria* Pack. As the moths vary considerably a number of them are shown in Fig. 181, Plate XVIII.

THE THREAD-BEARING SPAN-WORM.

(*Microgonia limbaria* Haw.).

This moth, formerly called *Nematocampa filamentaria*, is produced from a very singular caterpiliar, which is not uncommonly found upon the plum, apple, crab-apple, oak, hazel, strawberry and other plants, showing that it is a very general feeder. It measures not quite an inch in length, is of a grayish color, with dusky and blackish streaks, and bears on the posterior part of the fifth and sixth segments a pair of long, curved and fleshy horns, two of which extend forward and two curve backward (Fig. 182). The head is brown, and there are two short brown tubercles on the posterior part of the fourth segment, and two small gray warts on each of the segments behind, those on the eleventh being most prominent. As soon as this queer-looking insect has reached its full size it constructs a slight silken cocoon, composed of pieces of leaves fastened together with silken threads, and inside this shelter it changes to a reddish-gray or pale-brown pupa. About ten days later the perfect insect escapes.

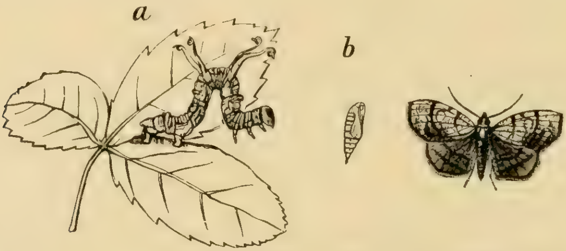


Fig. 182.—*Microgonia limbaria* Haw. From Div. of Entomology, Dep. of Agriculture.

This is a small moth of a pale ochreous color, marked with reddish-brown lines and dots, with a ring on the discal space, just beyond which is a dark lead-colored band, which becomes an almost square patch on the inner angle, and is continuous with a broad band of the same color on the hind-wings. The moths which fly during July and early August, measure a little less than an inch across. As they are not numerous enough to cause much injury no special remedies are given.

THE RASPBERRY GEOMETER.

(*Synchlora glaucaria* Gn.).

This is a very delicate moth, less than half an inch across the expanded wings, of a pale green color, crossed by two lines of a lighter shade. Its body is green above and white beneath. The moth is quite abundant, and can be seen flying about if we walk through fields in which grow patches of the plants upon which it feeds. It seems that the caterpillar prefers to eat the ripe berry, and that it does not care very much for the foliage, for which taste it surely can not be blamed. At all events the caterpillars reach their full size about the time that the raspberry ripens. They measure at that time about three-quarters of an inch in length, are of a yellowish-gray color, and each segment is furnished with sev-

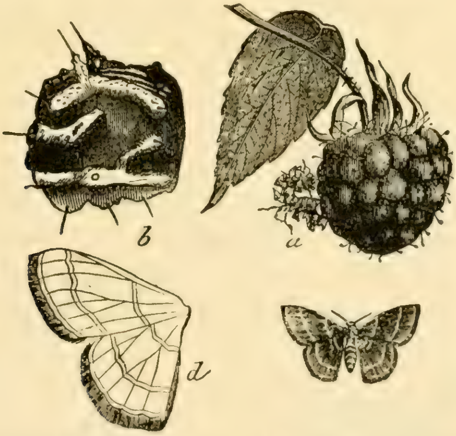


Fig. 183.—*Synchlora glaucaria* Gn. *a*, caterpillar; *b*, one segment of same; *d*, wings enlarged. After Riley.

eral short prickles. Like some closely allied caterpillars this one has the habit of disguising itself by attaching to the thorny prickles upon its body tiny bits of vegetable matter, such as the anthers of flowers, and by this means it often escapes detection. It makes a slight cocoon, and changes to a pupa of a yellow color with darker lines and spots, from which soon afterward emerges the perfect insect. The different states of this insect are shown in Fig. 183.

Besides the raspberry, the caterpillar also occurs upon the fruit of the blackberry.

It is not likely that this insect will ever become very destructive. If it does we can not depend upon any poisonous insecticides, as otherwise the fruit could not be used, but have to resort to hand-picking.

THE ABORTIVE DYSPTERIS.

(*Dyspteris abortivaria* H. S.).

This green moth is closely allied to the Synchlora. It expands about seven-eighths of an inch, and is of a pale-green color, with two oblique parallel white lines running through both wings. The moth can be recognized at once from all other similar colored ones by the great difference in size existing between the fore and hind-wings, the former being rather large, while the latter are not more than half as large as might be expected when compared with other moths of the same genus. The moth is not very common. It is shown in Fig. 184.

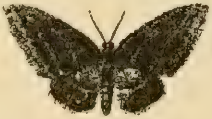


Fig. 184.—*Dyspteris abortivaria* H. S.

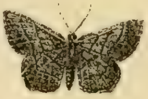


Fig. 184½.—*Eumacaria brunneraria* Pack.

The green caterpillar is stated to feed upon the leaves of grapes, one of which is rolled up by it and thus forms a shelter. It reaches its full size early in August, when it descends to the ground and where it transforms to a pupa among the rubbish found there.

THE PLUM GEOMETER.

(*Eumacaria brunnearia* Pack.).

The caterpillars of this beautiful geometer feed upon the leaves of the wild red cherry, but occur also upon plum and apple trees. They are nearly an inch long when they reach their full size towards the middle of July; their color is dull dark red, resembling very closely that of the bark upon which they rest. Their head is dark red, almost black, with white sutures; the longitudinal stripes usually found upon the sides of such caterpillars are simply represented by faint white lines; spots of the same color occur also upon the sides. The round spiracles are situated on small black tubercles. The caterpillars vary considerably both in colors and markings. At rest they are very difficult to detect, as they hold on only by their prolegs, their cylindrical, smooth and uniform body standing out like a short branch; sometimes they hold on to a leaf by their fore-legs, making their bodies appear like petioles. They descend to the ground and transform to rather stout dark brown pupæ with a rounded and smooth front; the last segment ends in a rather long spine with terminal hooklets. The pupa, which is not protected by a cocoon, remains in the ground over winter.

The moth is of a uniform brown color with but few markings. On the fore-wings are three transverse dark-brown lines; the hind-wings are somewhat paler and ochreous with two distinct dark lines. The moth expands about one inch across the wings. (Fig. 184½.)

THE VESTAL CORYCIA.

(*Corycia vestaliata Guen.*).

This delicate moth is snow-white, iridescent, with no markings; the long fringes are also white, as is the front of the head; the palpi are yellowish on the outer half, and the antennæ, which are white above, are sometimes brownish, and yellowish beneath. Brown stains occur along the under side of the costa of the fore-wings, as far as the apex. This moth has an expanse of wings of nearly one inch.

The caterpillar is stated to feed upon the foliage of the apple, but has not been seen, though the moth is fairly common.

THE CURRANT SPAN-WORM.

(*Eufitchia ribearia* Fitch).

The caterpillar of this rather common insect is quite destructive to the black currant and the gooseberry. It transforms into a moth which is frequently flushed while walking in places where wild currant and gooseberry bushes grow. The caterpillar, which measures when full grown a little more than an inch, is of a whitish color, with a wide yellow stripe down the back, another of the same character along each side, and a number of black spots of different sizes upon each segment. The under side is white, with a slight tinge of pink; it is also spotted with black, and has a wide yellow stripe down the middle. This brightly colored caterpillar resembles somewhat that of the European Harlequin caterpillar, and can become equally destructive to the gooseberry. Happily there is but one annual generation of this insect. When these caterpillars are disturbed they let themselves down very suddenly by means of a silken thread, and remain suspended in mid-air, or until the danger is past, when they reascend in the peculiar way called by sailors "hand over hand." This habit of lowering itself and remaining suspended can be utilizsd in the following manner to destroy large numbers of such insects: after striking the bush, a forked stick is passed all around under it and in this way all the hanging threads may be caught, and the caterpillars drawn out in groups and crushed with the foot.

The moth is of a pale yellowish color, with several brownish spots, which vary considerably in size and form, being prominent in some examples, where they may even form one or two irregular bands across the wings. The moth measures about an inch and a quarter across. Soon

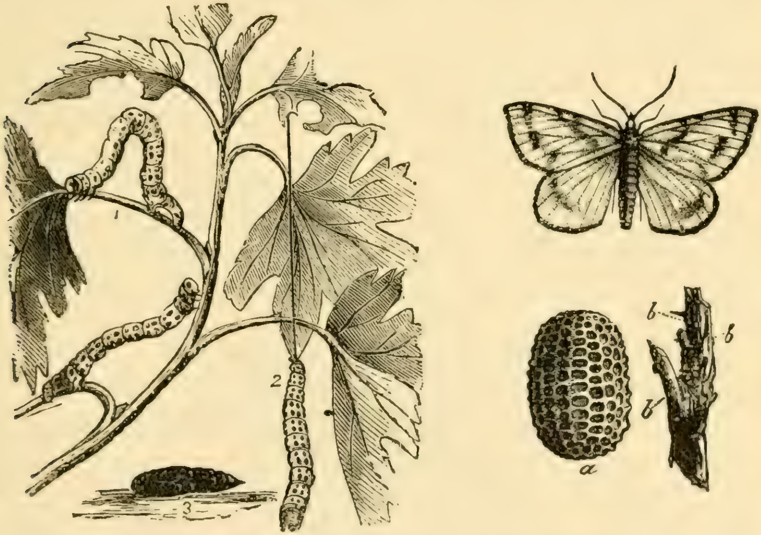


Fig. 185.—*Eufitchia ribearia* Fitch. After Saunders.

after emerging from the dark brown pupa, which was formed in a small cell in the ground, the female deposits her eggs for the next year's generation. These eggs, which are most beautiful objects, are loosely glued to the stems or twigs of the infested plants, and remain there until the following spring. It seems remarkable that such delicate and tender objects should be able to withstand the rain, snow and cold of our winters without the slightest injury. All states of this insect are shown in Fig. 185.

THE CHAIN-DOTTED GEOMETER.

(*Caterva catenaria* Cram.).

The moths of this interesting geometer appear sometimes in such very great numbers as to look like a snowstorm and on that account greatly alarm the people. But usually they are not very common for a number of years, when for some reasons, perhaps absence of parasites, or assisted by suitable climatic conditions, they again appear in large numbers. Here in St. Anthony Park the moth can always be found flying about during the middle part of September; the moths are diurnal, but fly in a rather uncertain manner and only for short distances, so that a trained eye immediately recognizes that they are not genuine butterflies. The moth is easily recognized by its large size and by its snow-white thin wings, marked with numerous black spots, which are arranged in two more or less plainly marked scalloped lines; in some cases the spots are dashes, which connect with the neighboring ones, thus forming continuous lines. There is always, even in very pale specimens, a distinct discal spot. The fringe of all wings is checkered with black dots. The head is ochreous-yellow in front; the thorax yellowish at the base of the shoulder-covers The male has a yellowish

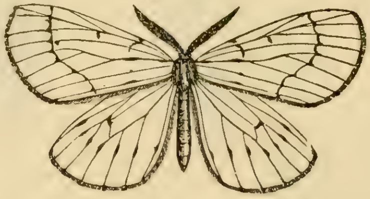


Fig. 186.—*Caterva catenaria* Cram. After Packard.

abdomem and very plumose antennae. Only a single brood is produced annually. The insect is shown in Fig. 186 and in Fig. 187, Plate XVI.

The caterpillar, which feeds upon the hazel, blackberry, raspberry and other plants, is very handsome; it has a smooth and cylindrical body of uniform thickness, a little thicker over the first abdominal feet, and lacks any protuberances whatever; it is of a pale straw-yellow color, with two subdorsal fine brown lines, and two smaller ones on the sides, interrupted by two large and conspicuous, angular, black dots, a pair on each segment. The head and prolegs are dotted with black. The caterpillar grows to about one inch and a half in length. When full grown it does not descend to the ground to pupate, but forms a slight but well formed web of thick yellow silken threads among the leaves. The pupa is bluish-white with a number of black spots.

The moths deposit a large number of beautiful eggs; as many as 368 were laid by a single female, which explains the fact that this insect can soon become very numerous.

THE COMMON CYMATOPHORA.

(*Cymatophora pampinaria* Guen.).

This is an exceedingly common moth, yet difficult to find, as it so thoroughly mimics the color and markings of the barks of trees upon which it rests that only well trained eyes can discover it. These moths vary greatly in color and markings but very little in size; they measure with expanded wings about one inch and a half across. The body and wings are pale ash, more or less clearly marked with three dark brown lines and numerous spots of the same color. Prof. Packard says: "that it may be known by the very distinct line at the base of the abdomen, the basal ring beyond being unusually white, and by the under side of the wings having a broad marginal shade, while the third line on the fore-wing is deeply but quite regularly situate, and near the costa acutely dentate." The caterpillars are general feeders but are also found upon the apple and blackberry. They vary considerably in color; some are very pale yellow with a broad reddish-brown dorsal stripe, edged with black; others are yellowish-green, while still others are gray or brown. They spin no regular cocoon, but protect their pupæ by a few silken threads. We have at least two annual generations which overlap in such a way that moths can be found all through the warmer part of the year. The adult insect is shown in Fig. 188.

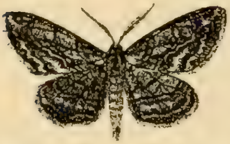


Fig. 188.—*Cymatophora pampinaria* Guen.

THE EUROPEAN CYMATOPHORA.

(*Cymatophora crepuscularia* Tr.).

This moth (Fig. 189) is slightly larger than *pampinaria*, but otherwise resembles it. Its color is whitish-ash, finely and uniformly dusted with brown. The fore-wings have also three curved dentate black lines, which extend over the lower wings.

The caterpillar is smooth and of uniform thickness; it is pale yellow on the sides, shading to creamy-white above. A straight light-brown stripe occurs on the back, and below it are several narrow, wavy dark-brown stripes close together; all stripes become obsolete on the last segment. The roundish head is a little wider than the body and reddish-brown in color. The pupa, half an inch long, is formed in the earth.

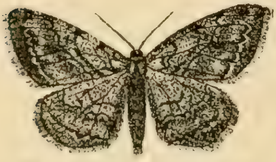


Fig. 189.—*Cymatophora crepuscularia* Tr..

This species is not nearly as common as the preceding one; it occurs also in Europe.

LARGE BLUE-STRIPED LOOPER.

(*Biston ypsilon* Forbes).

Early in August 1898 several nursery people complained about a large caterpillar that was causing some injury to young apple trees, many of which had been entirely defoliated. When visiting these nurseries on the following day the worms had all disappeared, and only a single specimen was found in the ground, very much contracted, as it was ready to pupate. As this insect is evidently capable to cause much injury the description given by Prof. Forbes is here repeated, ' The single male specimen bred is of a brownish gray color; head dusky gray; palpi black; antennæ dusky, widely pectinate; thorax gray, with three transverse dark lines, the anterior and middle arcuate, the posterior straight. The front wings are brownish-gray, speckled with black on the basal and terminal thirds, marked with three transverse black lines with the space between the first and third pale gray, minutely speckled with black, these specks taking the form of transverse lineations on the costa. The inner line is obliquely arcuate, its inner end being about half the distance of the outer from the base of the wing. The third line is sinuate, bending broadly forward around the end of the discal cell and then running nearly directly to the internal margin. The middle line is straight, and joins the inner end of the third before it reaches the internal margin. About one-half the distance from the third transverse line to the posterior margin is a jagged pale transverse line extending across the wing. The posterior wings are pale gray marked with two transverse lines, the inner of which is straight and the outer sinuous like that of the fore-wing. Beyond this is an obscure subterminal whitish band, upon the middle of the wing between these lines is a distinct black spot. The wing beyond the outer transverse line is more irroate with dusky, the fringe pale with blackened scales in the intervals between the veins. The first segment of the abdomen is covered with long gray pile; the remaining segments are fulvous brown, with a double row of black blotches along the middle.

"LARVA.—Length, when full grown, is two inches. The general color is a reddish drab, ornamented with numerous irregular longitudinal stripes of a reddish hue, with varied yellow and bordered with jagged lines of black. Four of these bands are continuous on the back, but vary greatly in width. On the sides they are much interrupted, the stripe below the spiracles being broken up into irregular patches. That immediately above the spiracles is regularly interrupted, disappearing at the middle of each segment. On the last two segments all the bands are much interrupted and very irregular. The dorsal stripes are confluent a little behind the middle of each segment, from the fourth to the eighth, with the exception of a central stripe of the ground color, by which all the transverse lines are broken. These confluent band-like areas of the longitudinal stripes, are, at first, yellow, but all change to a russet at the last moult, except the anterior one, which remains a bright lemon-yellow. The surface is smooth with the exception of a transverse row of about five black hairs to each segment, each arising from a minute tubercle. There is also a prominent tubercle behind each spiracle (excepting that upon the first segment) bearing a black hair at its apex. This row of later tubercles is variegated with rose and yellow, and each is surmounted by a jagged black line, which includes the black spiracle in the area described by it. The ventral surface has the same ground color as the dorsal, and is similarly marked with longitudinal stripes, which are, however, less distinct than the above. The head is irregularly punctuate, patches of the punctures being black, giving the surface a mottled appearance. The general color of the head and first segment is lighter than that of the other parts of the body. The anterior segment has a yellow front margin, interrupted in the middle by the median stripe already described. The legs are ringed with black and yellow at the articulations, and are elsewhere more or less spotted with black. Upon the antepenultimate segment are the two prominent black tubercles, one upon either side of the median stripe, each bearing a stiff bristle at its apex; and similar bristles are scattered over the dorsal surface of the succeeding segments. The last segments with the corresponding prolegs are punctuate with black, and bear two smaller sets of tubercles similar to those above mentioned. The preceding pair of prolegs are irregularly striped and mottled with black, rose and yellow, like the sides. Some transverse rows of minute black hairs are visible upon the under surface, two or three to each segment."

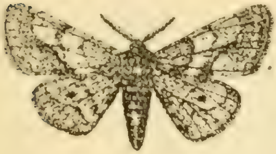


Fig. 190.—*Biston ypsilon* Forbes. After Forbes.

Fig. 190 is a copy of the illustration of this moth.

THE PEPPER AND SALT CURRANT-MOTH.

(*Eubyia* (*Amphidasis*) *cognataria* Gn.).

In some years this moth is very common and as it is readily attracted to strong lights it is frequently observed. It is not alone common near St. Paul, but seems to be equally common near Duluth. Like the preceding species this moth differs greatly from most Geometridæ by having

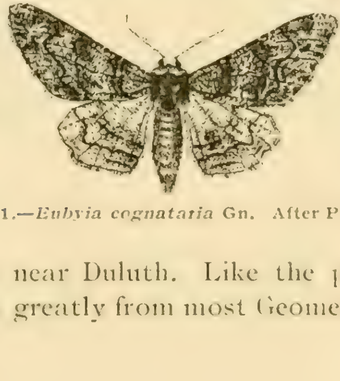


Fig. 191.—*Eubyia cognataria* Gn. After Packard.

a very stout body and wings, so that it looks more like a bombycid moth. Both fore and hind-wings are gray, dotted and streaked with black, and with a wavy light band crossing the wings beyond the middle. The under surface is paler than the upper; the body is gray, dotted with black. The moth expands two inches or more. It is shown in Fig. 191.

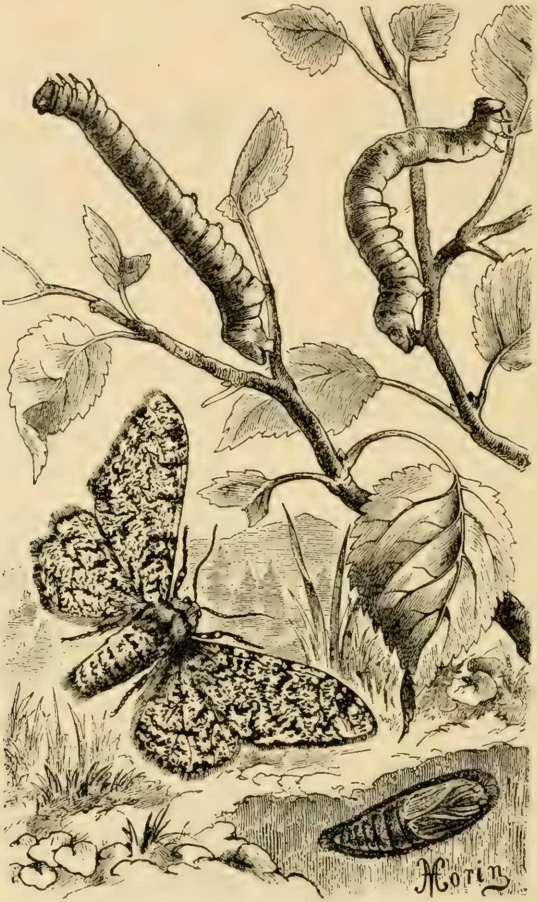


Fig. 192.—*Amphidasis betularia*. After Taschenberg.

The caterpillar is found very abundantly and often in destructive numbers on the currant; it feeds also on the plum and other plants. When full grown it is about two inches long; when at rest it is usually found clinging to a branch or leaf by its hind-legs, the body being extended straight out, so that it is easily mistaken for the stem of a leaf. It is pale-green, with an interrupted darker green line down the back, and indistinct broken transverse lines of the same color, and a yellow cross line on the posterior end of each segment. There are two small tubercles on the segment immediately behind the head; the body is dotted with very small whitish tubercles and a few short black hairs. In some cases there is a small brown tubercle on each side behind the middle, and a purplish brown ridge on the last segment. As soon as full grown the caterpillar enters the ground for pupation, which is performed in a smooth cell; the pupa is dark brown. A closely related European species (*Amphidasis betularia*) is shown in Fig. 192; the illustration shows the caterpillars in two characteristic positions.

THE LIME-TREE WINTER-MOTH.

(*Hybernia tiliaria* Harris).

The caterpillars of this moth feed chiefly upon the basswood, elm, hickory and others, but are also found in some numbers on the apple. In some years the moths, at least the males, are very common, and being attracted to the light are often found in large numbers on the street-lamps. They are most numerous late in the autumn, after all the foliage has been killed by frost. It is only the male that can fly, the female being a wingless, spider-like creature, with slender and thread-like antennæ, a yellowish-white body, sprinkled on the sides with black dots and with two black spots at the top of each ring except the last, which has but one. The head is black in front, and the legs are ringed with black. She is equipped with a jointed ovipositor, which can be lengthened or shortened at will, and which is used to deposit the eggs. The male has large and delicate wings and feathered antennæ. The fore-wings are of a rusty-buff color, with two transverse wavy brown lines, the inner often indistinct, while between the bands and near the edge of the wings there is generally a brown dot. The hind-wings are paler, with a small brownish dot in the middle; the body is similar in color to the fore-wings, which measure, when expanded, about an inch and a half across. The females, as soon as they emerge from the ground, late in October or even early in November, climb up the trees, and, after mating, deposit their oval pale-yellow eggs, covered with a net-work of raised lines, in little clusters on the branches.

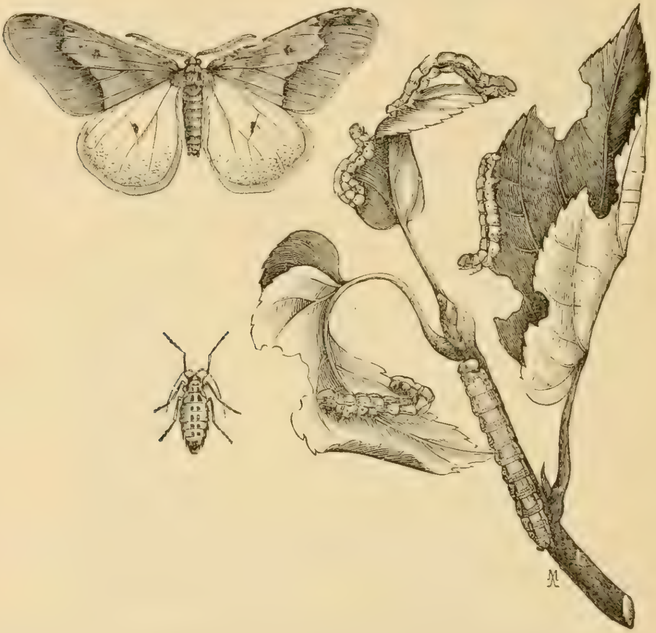


Fig. 193.—*Hybernia tiliaria* Harr. From Div. of Entomology, Dep. of Agriculture.

These span-worms, which hatch early in spring, are not unlike the true canker-worms, but are much larger and marked differently. The caterpillar has a dull red head, with a "V"-shaped mark on the front; the body is yellow above, with many longitudinal black lines; the under side is paler. When full grown these worms measure about an inch and a quarter in length. The different states of this moth are shown in Fig. 193.

THE WINGLESS PHIGALIA.

(*Phigalia strigataria* Minot).

This moth is also fairly common in Minnesota, the males flying about early in April. They are pale-ash, with dark brown specks and lines, which form three blackish transverse lines across the fore-wings, with a subterminal whitish line. The hind-wings are whitish, finely dusted with dark scales, which in well marked specimens are arranged in such a way as to form a continuation of the transverse lines of the fore-wings. The antennæ are strongly pectinated. The wings have an expanse of about an inch and a half. The female is wingless, of a light gray color with a slight olive tint; her body is mottled all over with black, the spots above being large those below fine. The thorax is nearly uniform black; the short head, scarcely seen from above, is grayish black; the clypeus and antennæ are black, the latter annulated with the ground color of the body. The divisions between the extended segments of the abdomen are

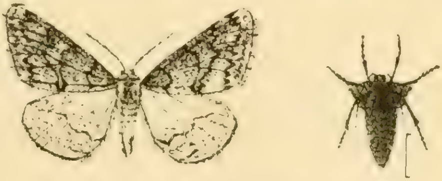


Fig. 194.—*Phigalia strigataria* Minot.

pea-green. The rudimentary hind-wings reach to the back part of the first abdominal segment; the fore-wings to the middle of the same segment. The exerted ovipositor consists of two joints, the last third of the posterior one having the hairs perpendicular to the joint. Both sexes are shown in Fig. 194.

The pupa is dark brown, coarsely punctured, the divisions between the abdominal segments finely so; the last segment is conical, smooth at the end, and tipped with two short, stout, divergent bristles.

The caterpillars are found on the apple, rose, blackberry, elm and other plants, and have thus far never become numerous enough to cause injury. They are about an inch long, dark-brown or dusky reddish-brown with dirty white or gray dorsal and dirty yellow lateral lines. They reach their full size in June, when they enter the ground for pupation and hibernation.

CANKER-WORMS.

There are two kinds of canker-worms which are known to be very destructive to the orchards, especially to the apple-trees. A third species is found in the northern portion of our state, sometimes in such immense numbers as to defoliate large tracts of forest-trees. It has thus far not been found upon fruit trees, but prefers the linden, ash and elm, but when very numerous no foliage escapes its voracious appetite, and the caterpillars pass through the forests like a devastating fire. They hatch very early in the season, and perforate the leaf-buds, thus causing much more damage than if they would simply eat the unfolded leaves. As no males have been raised thus far this third species remains undescribed; the females are wingless and deposit their numerous eggs in perfect rings around a small twig, in this respect resembling the tent-caterpillars.

THE SPRING CANKER-WORM.

(*Paleacrita vernata* Pack).

This canker-worm appears in its winged form early in spring, although specimens are also sometimes found late in autumn. The females, which are wingless, ascend the trunks of trees to deposit their eggs. These are of a very delicate texture and of a pearly lustre; they are deposited in masses of several hundreds, without regularity, and are usually well hidden in the crevices of the bark. The young caterpillars are of a dark olive-green or brown color, with black shining heads, and a horny cervical-plate of the same color. When full grown they are about an inch long, of very variable colors. The head is usually mottled and spotted, and has two pale transverse lines in front; the body is longitudinally striped with many narrow pale lines; along the sides it becomes deeper in color, and down the middle of the back are some dark spots. When mature these caterpillars descend to the ground in which they penetrate to some depth and where they make a rather fragile cocoon.

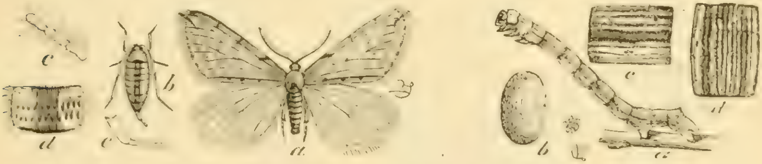


Fig. 195.—*Paleacrita vernata* Pack. After Riley.

The female of this canker-worm, as well as the male, has upon the posterior margin of each segment two transverse rows of stiff reddish spines. The female has a long and retractable ovipositor, which is not found in the Fall Canker-worm. The male has pale ash-colored or brownish-gray silky fore-wings, which are so thin as to be almost transparent. A broken whitish band crosses the wing near the outer margin and three interrupted brownish lines are found between that and the base; there is also an oblique black dash near the tip of the fore-wings, and a nearly continuous black line at the base of the fringe. The hind-wings are plain pale ash-color, or very light gray, with a dusty dot about the middle. All stages of this canker-worm are given in Fig. 195.

THE FALL CANKER-WORM.

(*Anisopteryx pometaria* Harr).

This delicate moth is sometimes flushed late in autumn, and frequently after all foliage has been killed by frost, when we walk along the edges of forests. The moth flies in bright sunshine, as if to enjoy the few brief hours of its existence. It is a very frail being, with wings so thin as to be almost transparent and it almost seems that it was most decidedly out of place at this late season. But notwithstanding their frail bodies all canker-worms here and in Europe are very hardy, and seem to require for their perfect health and well-being a considerable degree of cold. All the moths of this insect that we obseve flying are males, the female lacking wings for this purpose. The latter is a spider-like and sluggish being, usually having the body so distended with eggs that she has to drag it in a rather ungainly manner. All she tries to do is to reach a tree, which she climbs, and there awaits the arrival of her winged mate. Her body is uniformly colored; it is shining ash color above, gray beneath, and measures from three to four-tenths of an inch in length. The male has brownish fore-wings, which are very glossy and silky, and are crossed by two rather irregular whitish bands, the outer one enlarging near the apex, where it forms a large pale spot. The hind-wings are grayish-brown with a faint central blackish spot and a more or less distinct whitish band crossing them.

The eggs of the Fall Canker-worm are flattened above, and have a central puncture and a brown circle near the border; they are deposited in regular masses, side by side, and as many as a hundred together. In most cases they are laid in exposed situations on the twigs or branches of the tree selected. They hatch about the time when the young leaves of the apple just expand, and this delicate food is greedily devoured by the young worms which cluster upon them. Here they enjoy life, being well hidden by the still small and curled leaves. The young caterpillar is pale olive-green with a pale head and cervical-plate. Mature, it reaches a length of about an inch. The caterpillars vary greatly in color, from greenish-yellow to dusky or even dark brown; they have broad longitudinal yellowish or paler stripes along their sides. Like nearly all loopers they assume when

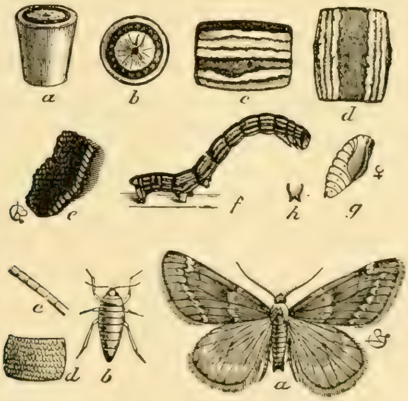


Fig. 196.—*Anisopteryx pometaria* Harr.; *a*. *b*, single eggs; *e*, egg mass; *c*, *d*, joints of caterpillar; *f*, caterpillar; *g*, pupa. Below, *a*, male moth; *b*, female moth *d*, one joint of same. From Div. of Entomology, Dep. of Agriculture.

not feeding a stiff posture, either flat or parallel with the twigs on which they rest, or at an angle of about forty-five degrees. In this position, kept up for many hours at a time, they so closely resemble in color and shape a small twig that they are not readily detected. When full grown they either descend the tree on foot, or they let themselves down from the branches by silken threads. When thus suspended in great numbers, as is frequently the case, they become a great annoyance to people passing under such trees. In this manner they are also carried by passing vehicles to places not yet invaded by them. As soon as they reach the ground they burrow in it to a depth of from two to six inches and there they form a rather tough cocoon of buff colored silk interwoven with particles of earth. The pupa is about half an inch long, of a light grayish-brown color; that of the male is slender and furnished with wing-cases. The pupæ remain in the ground until late in autumn when the moths emerge.

Remedies.—With the exception of the one species of canker-worms so destructive to forest trees in the lake region of Minnesota these insects are not as yet of a threatening nature in our state. Both species are found, however, and it is simply a question of time when they will become more numerous. At present orchards are by no means found near every farm house, but the time is rapidly coming when this will be the case, and with more orchards the large number of injurious insects living in them will also become more numerous and destructive. These insects are rather easy to destroy with any of the arsenical preparations; in fact they were about the first tree-infesting species that were destroyed by these means. But in case of large trees it is not easy to apply them, and here we have to apply other remedies based upon the fact that the wingless females have to ascend the tree to deposit their eggs, which we can and should prevent. Prof. Saunders writes: "To attack an enemy with success, it is essential that we know his vulnerable points. In this instance since the females are without wings, if they can be prevented from crawling up the trees to deposit their eggs, a great point will be gained. Various measures have been employed to secure this end, all belonging to one or other of two classes, first, those that prevent the ascension of the moth by entangling her feet and holding her there, or by drowning her; second, those which look to a similar end by preventing her from getting a foot-hold and causing her to fall repeatedly to the ground until she becomes exhausted and dies. In the first class is included tar mixed with oil to prevent its drying, and applied either directly around the body of the tree, or on strips of old canvas or stiff paper, about five or six inches wide, and tied in the middle with a string; refuse sorghum molasses, printer's ink, and slow drying varnishes, are used in a similar manner. Tin, lead and rubber troughs, to contain oil also belong to this class of remedies, and have all been used with more or less success. In the use of any of the first named sticky substances, it should be borne in mind that they should be kept sticky by frequent renewal of the surface in mild weather, or the application will be useless; they should also be applied as early as the latter part of October, and kept on until the leaves are expanded in the following spring. It must also be remembered that some of the moths, defeated in their attempts to climb the trees, will deposit their eggs near the ground or anywhere in fact, below the barrier, and that the tiny young worms hatched from them will pass without difficulty through a very small opening. Hence, whether troughs or bandages are used, care must be taken to fill up all the irregularities of surface in the bark of the trees, so that no openings shall be left through which they may pass. Cotton batting answers well in most cases for this purpose.

"The second class of remedies consists of various ingenious devices, in the way of collars of metal, wood or glass fastened around the tree and sloping downwards like an inverted funnel. These, although they prevent the moths from ascending the tree, offer but little obstacle to the progress of the young caterpillars unless the openings between the collar and the tree are carefully packed, and hence they often fail of entire success. Those belonging to the first class are said to be the surest and best, and while it must be admitted that it involves much time and labor to renew so often and for so long a period the tar or other sticky application so as to make it an effectual barrier to the ascent of the insect, still it will pay, wherever the canker-worm abounds, to give this matter the attention requisite to insure success. The limited power of motion possessed by the female usually confines this insect within narrow limits, and hence it is local in its attacks, sometimes abounding in one orchard and being scarcely known in a neighboring one; but when it has obtained a footing, and is neglected, it usually multiplies prodigiously. Strong winds will sometimes carry the larvæ from one tree to another near by. When the caterpillars are once on a tree, if the tree is small, they may be dislodged by jarring, when they all drop suspended in mid-air by silken threads; then by swinging a stick above them the threads may be collected and the larvæ brought to the ground and destroyed. Fall plowing has been recommended to destroy the chrysalids by turning them up, when they are likely to be either killed by exposure or devoured by birds. Hogs also are very useful in destroying this pest by rooting up the chrysalids and eating them." The use of "Raupenleim" has given very good results, and as this material remains sticky for a long time it is better than simple tar, etc.

Canker-worms have many enemies which assist us greatly to keep them in check. The eggs are devoured by a small red-mite, and a very small wasp finds the minute eggs large enough to furnish food for her offspring, hence she deposits her eggs into the larger ones of the canker-moths. The caterpillars themselves are preyed upon by larger parasitic wasps and flies, and predacious insects also feed upon them in large numbers. One of our Caterpillar-hunters (*Calosoma frigida* Fig. 145), a large black and active beetle, is found in large numbers in Minnesota wherever canker-worms have greatly increased in numbers, and they make war upon them day and night. These beetles are just as active as their green relatives farther south, and climb with equal facility. It is amusing to see them running over the foliage or racing up and down the trunks of the tree, trying to reach with their front feet the worms suspended by silken threads. Evidently the caterpillars realize their danger, because if we imitate the motion of one of these beetles with a little stick upon a leaf all the worms immediately drop, but remain suspended in the air until they imagine all danger is past. Insect-eating birds devour large numbers, and Shrews and Skunks find and devour the caterpillar above and below the ground. Spiders prove also of great help, as do some large wasps, such as the Potter-wasps, which store the clay-cells made by them with canker-worms, as many as twenty being found in a single cell.

These canker-worms are general feeders but are partial to the plum, cherry, linden and elm. The different states of this species are shown in Fig. 196.

THE WINGLESS OPEROPHTERA.

(*Operophtera bruceata* Hulst).

This moth is closely allied to the canker-worms and like them possess a wingless female; in Europe it is also almost as destructive. It is not common and the male can be readily recognized from the true canker-worms by having the ochreous fore-wing more rounded and ornamented with many wavy lines; it is illustrated in Fig. 197. The caterpillars feed upon the apple and other plants.

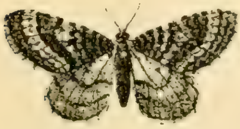


Fig. 197.—*Operophtera bruceata* Hulst.; male.

THE SCALLOP-SHELL GEOMETER.

(*Calocalpe undulata* Linn.).

This is a rather common moth, but always attractive on account of its beautiful marking. It has white or yellowish wings, the upper ones crossed by at least twelve fine zigzag dark-brown lines, so that it is difficult to say what is really the ground color; the hind-wings are crossed by six light lines, which become whitish toward the outer edge of the wing, as well as more scalloped. Below the wings are clearer, with the lines more obsolete, but the discal spots large and distinct. With expanded wings this moth measures about one inch and a half. It is shown in Fig. 198.

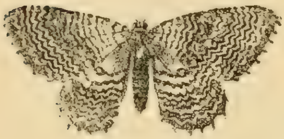


Fig. 198.—*Calocalpe undulata* Linn.

The caterpillars hatch from eggs which were deposited in a cluster on a leaf near the tip of a twig, usually on the wild cherry. They form an exception to most other loopers by being gregarious. They spin a snug nest by fastening together the leaves at the end of the twig, inside which they live, adding to the nest if more space and food is required. As the enclosed leaves die and become brown, and as the dark excrement also accumulates, such nests become conspicuous and can easily be seen and removed with their contents. The caterpillars, which are quite sluggish in all their motions, are black above with four white stripes, and flesh-colored below. They transform in the earth, in which they also pass the winter.

THE GRAPE-VINE PETROPHORA.

(*Petrophora diversilineata* Hub.).

This pretty yellow moth, also called the "Diverse-lined Geometer," is very abundant in Minnesota, flying from late in June to early in September; it is often attracted to light and enters our houses at night, settling on the walls with its abdomen curved over the back (Fig. 199, Plate XIV.) It varies in size, measuring with expanded wings from an inch and a quarter to fully two inches. It is shown in two forms in Fig. 199.

The body and wings of this insect are ochreous-yellow, often pale in the middle and basal portions. The fore-wings are crossed by three rusty-brown curved lines, the outer strongly dentate in the middle; beyond this is a subterminal faint line, not always distinct. The hind-wings are paler than the fore-wings, clear, usually without lines except in the outer third near the anal angle, where there is a faint brown line edged on the outside with white. At the anal angle is a dark spot composed of two brown lines, with violet-brown between them. The moths vary greatly in intensity of colors and markings, some being almost plain yellowish-brown with but very few indistinct bands, of which the outer dentated one is always visible.

The moths deposit their eggs upon the leaves of the grape-vine, from which the young caterpillars hatch a few days later, reaching their full size in about four weeks. They are then about an inch and a quarter long, have a dull reddish-brown head, a yellowish-green body, with a few small whitish dots on each segment. On each side of the second segment is a small reddish spot and on the third a larger one of a darker shade; on this latter segment there is a fold in the skin, which makes the spot appear as a brown prominence. On the terminal segment are two short greenish spines, which extend backwards; the surface of the body is wrinkled; the under surface is reddish, with a central reddish line bordered with white, which is margined with dull red. These caterpillars are also very variable in color, but are always well protected by blending with the surroundings; when disturbed they straighten themselves, remaining per-

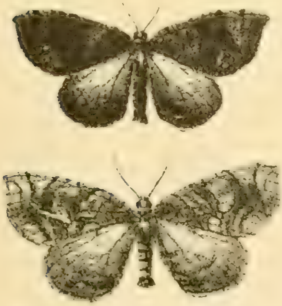


Fig. 199.—*Petrophora diversilineata* Hub.

fectly quiet for a time, and resemble the twigs so thoroughly that is very difficult to detect them. When they are full grown they hide in some shelter, and thus pass the winter; early in spring they leave their hiding places and after eating for a few days they transform to pupæ and soon afterwards to moths.

At present these caterpillars are found most abundantly in places where wild grapes are growing, but they are by no means strangers to our vine-yards, where they eat a large amount of foliage, thus sometimes causing some slight injury. Being so well protected by shape, color and position they may be very common on our vines, yet are not recognized.

THE CURRANT FRUIT WORM.

(*Eupithecia interrupto-fasciata* Pack.).

This is not a common moth, at least it is not often found in our gardens. But the fruit of wild currants frequently show its presence, or rather that of the worms. These are about five-eighths of an inch long, and very variable in coloration and markings. Their bodies are usually of a pale-ash or yellowish-green color, with a dark line down the back and another one on each side, which is, however, frequently absent. In some cases there is a row of dark-colored lozenge-shaped spots along the dorsal line, and a second lateral line lower down. The terminal segment carries two short greenish lines; the under side of the body is pale-greenish and almost white, with a yellowish line in the middle. The head varies from yellowish or greenish to light brown. When full grown the caterpillar draws together a number of leaves and other material, fastens them with silken threads, and in this shelter changes to a pupa and later to a moth.

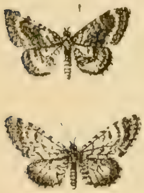


Fig. 200.—*Eupithecia interrupto-fasciata* Pack.

The small moth has bluish-gray fore-wings, with a bluish dot near the center of each, and a dark line crossing them immediately beyond the dot. Two forms are illustrated in Fig. 200.

All the following moths are usually called "micro" or small, although as a matter of fact some of them are as large or even larger than a few of the "macros" described before. But generally speaking all are small. They are also divided into many superfamilies and families.

PYRALIDIDÆ.

This super-family includes moths of medium and small size, which differ so greatly in appearance, however, that it is not possible to give a general description that would serve to characterize the same. It includes a number of families that contain numerous insects injurious to plants.

FAMILY PYRAUSTIDÆ.

These moths have slender bodies rather thinly covered with scales. The caterpillars are nearly always green, with pale stripes and spots, and without any markings whatever. Their head is either black or yellow, hard and polished; so is the rather prominent cervical-shield on the first thoracic segment. Most of them have the abdominal or false legs crowded with a complete circlet of spines, and by this character, which is easily seen, we can tell with almost absolute certainty the caterpillar of a *micro* from that of a *macro*, in which the circlet of hooks is never complete. The caterpillars of the *Pyraustidæ* differ from those of the loopers by possessing all four pairs of prolegs. Most of them can produce a little silk, and they live often more or less concealed in leaves folded and tied together in various ways. Some few are gregarious and build large nests. Most of these caterpillars cause no injury to cultivated plants, while some of them are decidedly destructive.

THE GRAPE-VINE LEAF-FOLDER.

(*Desmia maculalis* Westw.).

It is a good thing that this insect prefers the South, and is not often met with in Minnesota, although it is found here both upon the wild and cultivated grape-vines. It can become a very destructive insect and one that is not readily combatted.

We see frequently the leaves of the grape folded or rolled up by means of numerous little cords of silk; if we unfold these we find the enclosed leaves skeletonized by a very active worm, a little less than an inch long and remarkable on account of its violent wriggling motions. In most cases the caterpillar wriggles out of the folds and drops either to the ground or suspends itself by a silken thread. If the worm is full grown it is yellowish-green, a little darker above, glossy and semi-transparent, with a few fine yellow hairs on each segment. Its head is reddish-yellow; the cervical-shield has a crescent-shaped patch of the same color; on the third segment are two or three black spots on each side, and on the twelfth segment is one. The caterpillars transform to a reddish-brown pupa, about half an inch long, either within the folded leaf or more usually within a much smaller fold of the edge of the leaf. In the Southern States there are two and even three annual broods, the last one hibernating in the leaves. The first moths appear here early in June, and deposit their eggs singly on the leaves of the vine; the moths of the second brood are found early in August.

The moths, which expand about an inch, are pretty insects with shining opalescent black wings, lightly fringed with white; the fore-wings have two white spots, nearly oval in form; the hind-wings but one large white spot in the male, which in the female is divided into two. The body is black, crossed by two white bands in the female, by one in the male. The male insect has the antennæ elbowed and thickened near the middle, a character not seen in the female, where the antennæ are uniform and thread-like. Though fairly common the moths are not often seen, as they hide among the leaves, but if the vines are shaken they seek and find escape in quick flight, and make for the next shelter. The insect feeds upon all kinds of grapes, but shows some little preference for the thicker leaved varieties. The upper surface of the leaves is eaten by the worms, and for this purpose the leaves are almost invariably folded in such a manner as to bring the upper sides of the leaves together. Fig. 201 shows the different stages of this insect.

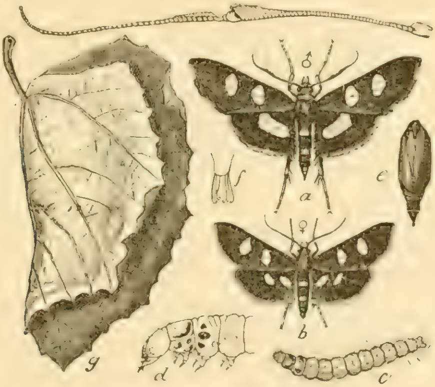


Fig. 201.—*Desmia maculalis* Westw ; *a*, male moth; *b*, female; *c*, larva; *d*, head and thoracic segments of same enlarged; *e*, pupa; *f*, tip of same enlarged; *g*, leaf folded by larva. From Div. of Entomology, Dep. of Agriculture.

Remedies.—As it is easy to detect the folded leaves the caterpillars enclosed in them can be crushed, and if this is done carefully and at a time when the insects are not yet numerous this remedy is a good one. The treatment with arsenical poisons is not as successful, as the inside of the folded leaf can not readily be reached.

THE CRANBERRY FRUIT-WORM.

(*Mineola vaccinii* Ril.).

This insect is a very injurious one in places where cranberries are grown on a large scale for any lenth of time. Its caterpillar stands in the same relation to the cranberry as the apple-worm to the apple, and the grape-fruit worm to the berry. The moth is dull gray; the fore-wings are reddish-brown and tawny on their inner portions, and with the pale costal parts nearly pure white, which strongly contrasts with the dark shades, and fully relieves the basal branch of the forked shade on the inner part of the basal line, which is usually darker than the posterior branch. The hind-wings are pale gray, without any markings. The eggs, which when laid are soft and adapt themselves more or less closely to the object to which they are attached, are laid singly, and generally on the lower end of the forming fruit, or in the scar left by the flowers, or under the four flaps that cover the scar, being thus well sheltered and difficult to detect; sometimes they are deposited upon the surface of the young fruit. Their color is white, with a faint yellowish tinge. As soon as the caterpillars hatch they eat their way into the heart of the berry, and not satisfied with one they go to the neighboring ones, thus ruining from three to four berries before they reach their full growth, which takes place when the fruit is ripe. The caterpillar now stops the last entrance hole with a silken web; the affected berry turns prematurely red and finally shrivels and drops. The worm is at first pale, but becomes green, with more or less pink, and reaches a length of about half an inch. Such caterpillars are found of all sizes during autumn, a few even persisting until winter; most of them leave, however, the ripening berries in September or October, and find shelter in the higher ground, where they hibernate in an ovoid cocoon of silk, covered with grains of earth and sand. The brownish-yellow pupa, with brown stigmata and a shallowly punctate abdomen, is formed the following spring, and the moths issue quite regularly during the month of June, or by the time the cranberries are forming.

As the growing of cranberries is becoming quite an important branch of horticulture it will not be out of place to mention the remedies suggested by the Division of Entomology: "The arsenical mixtures carefully sprayed during June and July so as to reach the calyx cavity, will prove the most satisfactory preventive of this insect's injuries by killing the young larva as it attempts to eat its way into the berry, while experience would indicate that the natural growth of the berry, together with the effect of summer rains, will rid the fruit as it matures of whatever trace of the poison might prove injurious." Keeping the cranberry bog as wet as possible during July also seems to be a good remedy. The life-history of the insect is shown in Fig. 202.

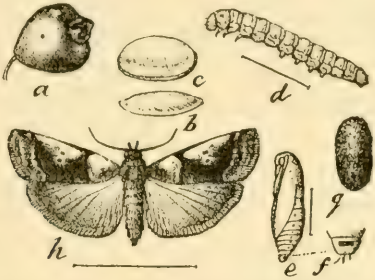


Fig. 202.—*Mineola vaccinii* Ril. From Div. of Entomology, Dep. of Agriculture.

THE LEAF-CRUMPLER.

(*Mineola* (*Phycis*) *indigenella* Zell.).

This injurious insect is becoming very numerous in Minnesota, and steps should be taken to destroy it now. It seems to be equally fond of the foliage of the apple, plum and cherry. When we examine the trees late in autumn or during winter we find fastened to the twigs some crumpled and withered leaves. If these are investigated a little closer we can detect, well hidden among these leaves, clusters of peculiar little cases, which resemble minute horns, open at one end, tapering to almost a point at the other, and twisted in all sorts of manner. The withered leaves are very firmly fastened to these little horns and to the twigs by strong silken threads; the horn itself, tightly attached to the bark, is constructed of silk interwoven with the dried excrement and frass of the worm. Its inner surface is smooth and whitish, its exterior rough and brownish. When we open one of these little cases we find in it a small caterpillar, which was born late in summer, and had reached about one-third of its full size before making and entering the case for hibernation. Early in spring, when the buds of the trees commence to expand, these caterpillars also become active again, and with an appetite sharpened by the long fast they leave their cases or homes, usually during the night, and draw the still young and minute leaves towards their dwelling-places, fastening them by means of some threads of silk; they can now enjoy a meal upon their very doorsteps, having at the same time a safe retreat in case of danger. Here the caterpillar thrives until it has reached its full size, when it measures about six-tenths of an inch in length. Its body, which is slightly tapering towards the posterior end, is of a dark, dull, greenish-brown color; the head is dark reddish-brown; the first segment has a horny plate at the top and a flattened blackish prominence on each side, below the plate; on each side of the other segments are several small blackish dots, from every one of which arises a single brown hair. By the early part of June the caterpillar is mature; it now shuts itself up in its case and changes to a reddish-brown pupa, about four-tenths of an inch long, from which the moth escapes about two weeks later.

This moth has pale brown fore-wings, with patches and streaks of silvery-white; the hind-wings are plain brownish-white; the under side of both wings is paler. With expanded wings the moth measures about seven-tenths of an inch across. There is but one annual generation.

Notwithstanding the protection of this snug case the caterpillar is by no means secure from enemies and several parasites are known which keep this insect in check. The insect is illustrated in Fig. 203.

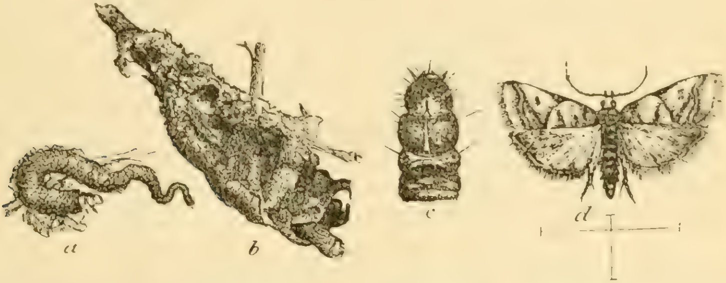


Fig. 203.—*Mineola indigenella* Zell.; *a*, a single case; *b*, case covered with leaves; *c*, front part of caterpillar; *d*, moth. After Riley.

The best remedy we possess against it is to pick off the cases with the crumpled leaves during the time when the tree is bare of foliage, and to burn them. In extreme cases an early application of any of the arsenical insecticides will prove successfull.

THE WALNUT CASE-BEARER.

(*Mineola juglandis* LeB.).

There are a number of other case-inhabiting caterpillars and the one living on the walnut and hickory is found quite often but by no means as common as the one just described. The caterpillar of this insect makes a straight case, which is also much more neatly woven together on the outside. It is attached with its smaller posterior end to the main leaf-stalk, and the caterpillar draws down and fastens two of the leaflets to hide it and then feeds upon it from the point to the base. The caterpillar has the same general appearance and is of the same size as that of the apple-leaf crumpler but is darker greenish. It has many enemies and there is hardly a necessity at present to fear its occurrence. If it should become more numerous, especially in our windbreaks or where walnut trees are planted in large numbers, it can be kept in check like the closely allied insect described before. It is shown in figure 204.

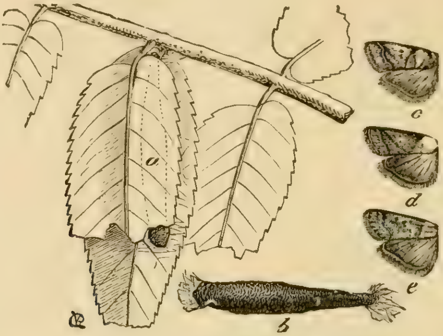


Fig. 204.—*Mineola juglandis* LeB.; *a*, case indicated; *b*, case; *c*, *d*, *e*, wings. After Riley.

THE GOOSEBERRY FRUIT WORM.

(*Zophodia grossulariæ* Pack.).

Many of our farmer's wives depend on wild gooseberries for preserves, and as our state abounds in such fruit there is usually no lack of material for this purpose. But notwithstanding the abundance of these berries there are seasons when the crop is destroyed entirely, or at least reduced very materially, by the presence of the above insect, the larvæ of which burrow into the berries. As they grow larger they fasten a number of berries together with silken threads; they even cut off the stems of some so that they can be brought into the desired position. These united berries form a shelter and a storehouse of food. Only a single hole is made in each berry just large enough to admit the body of the worm. Like all caterpillars of such insects these worms are very active, and if their house is ever so little disturbed they leave it very suddenly and drop to the ground by a silken thread, which enables them later to re-ascend to their dwelling places. When full grown this caterpillar, which is shown in Fig. 204½ suspended by a thread and also upon a berry, is about three-quarters of an inch long; its body is thickest in the middle, tapering slightly toward each extremity, of a pale green color, sometimes with a yellowish or reddish tint, glossy and semi-transparent. It has a small, horny and pale brown head, the cervical-shield has also the same color. Before the berry ripens the larva drops to the ground where it makes a snug, brown and paper-like cocoon among the dead leaves and rubbish; inside this safe shelter it transforms to a brown pupa, which remains inactive until the following spring. There is but one annual generation.

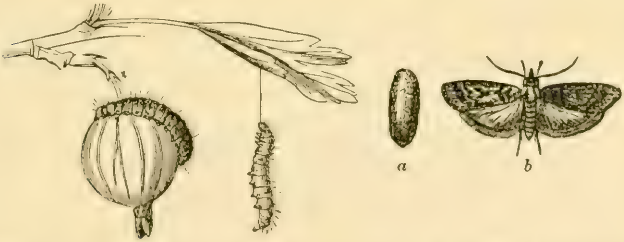


Fig. 204½.—*Zophodia grossulariæ* Pack.; *a*, cocoon; *b*, moth. After Saunders.

The moth appears soon after the gooseberry is past flowering, when it deposits the eggs upon the fruit just formed. The wings of the moth expand nearly an inch across; "the fore-wings are pale gray, with dark streaks and bands, there is a transverse diffuse band a short distance from the base of the wing, enclosing an irregular whitish line which terminates before it reaches the front edge of the wing. Near the outer edge is another transverse band enclosing a whitish zigzag line, there is also a row of blackish dots within the outer margin, while the veins and their branches are white, the hind-wings are paler and dusky. The head, antennæ, body and legs are all pale gray, whiter below than above." (Saunders).

The insect is not easily combatted, but as it can readily be detected it can also be destroyed to some extent by hand picking. If neglected it increases very rapidly and no berries can be expected until parasites or unsuitable climatic conditions come to our assistance. Chickens running among the bushes after the fruit has been gathered will find and eat many of the pupæ. The removal and burning of all rubbish is also of some value, and in extreme cases the proper use of arsenical poisons is recommended.

THE AMERICAN PLUM-BORER.

(*Euzophera semi-funeralis* Walk.).

Professor Forbes has described this insect in detail, and as a few specimens have been received from a nursery there is no doubt that it occurs in the state. The caterpillars attack the plum-tree near the forks, especially at the base of the lower limbs; in such places they crowd together and destroy the bark in large irregular patches.

Prof. Forbes writes: "Living borers received 3 November were about half an inch in length, of a greenish dusky color, with only a few scattered hairs springing from small dark specks. The head was reddish-brown, with a darker triangular patch in the middle, and the top of the first segment behind the head, the cervical shield so called, varied from yellowish to pitchy, more or less shaded with brown, but with a median yellow patch. This borer has, of course, the three pairs of legs and the fleshy prolegs (ten in number) of the caterpillar. From the peach-borer, whose structure is similar, it may be distinguished by its dusky color (the other being white), its smaller size when full grown, and with a glass by the hooks on the prolegs. In the peach-borer the ends of the soft stump-like legs are provided with small brown hooks, arranged in two opposite curves discontinuous at their ends, each of a single row; while in the new plum-borer the corresponding hooks form a complete ring, nearly covering the end of the leg.

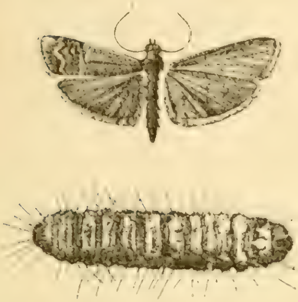


Fig. 205.—*Euzophera semi-funeralis* Walk. After Forbes.

"Kept in a breeding cage and supplied with the chips and twigs of the plum trees, our larvæ spun small webs in which they passed the winter. By 3 May a part of them had pupated, and 28 and 29 May two winged moths emerged, all the others failing.

"These moths were small gray insects, the extended wings measuring about eight-tenths of an inch. The fore-wings were reddish behind (within); the hind-wings were plain." Illustrated in Fig. 205.

THE APPLE-LEAF SKELETONIZER.

(*Canarsia Hammondi* Ril.).

In some regions of the United States this insect is very numerous and correspondingly injurious. As it is also found in Minnesota its life-history is given, so that in case it should become destructive it may be recognized and treated accordingly.

The leaves of apple-trees, and especially of the younger ones in the nurseries, appear sometimes blighted, corroded and rusty. If we search for the cause for this injury we shall find it to be produced by the gnawings of little worms, the young of this insect, which feed solely on the green pulpy parts of the upper surfaces of the leaf, not touching the harder and more fibrous frame-work of the same. In extreme cases this green substance has been so thoroughly removed by the jaws of the worms that nothing remains but the semi-transparent epidermis below and the net-work of veins; in most cases, however, a little of the parenchyma is left, which assumes a bright russet-red color. The caterpillar always covers the leaf with loose silken threads, with which are mixed the minute grains of the gunpowder-like excrement; below this covering it is protected and here it feeds singly or in groups; in the latter case a number of leaves are drawn together to give additional shelter. The caterpillar is pale-brownish, about half an inch long, and marked with four conspicuous black shining tubercles, with a pale basal annulation near the head. The pupa is generally formed among the leaves in a very slight cocoon; it is of a pale brown color and about a quarter of an inch long. In confinement the caterpillars go below the surface of the ground, and in this case they cover their cocoons with grains of sand. The insect hibernates in the pupal state. The insect is shown in Fig. 206.

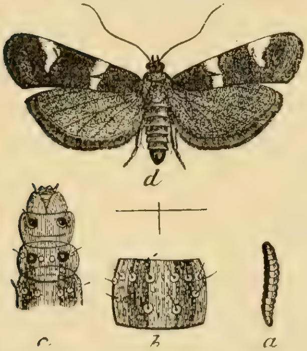


Fig. 206.—*Canarsia Hammondi* Ril; *a*, larva; *c*, front part of same, enlarged; *b*, on joint still more enlarged; *d*, moth. After Riley.

The strangely marked moth has the fore-wings of a deep, glossy, purplish-gray, marked with two silver-gray transverse bands.

This insect is also preyed upon by a number of parasites, which in Minnesota seem to be able to keep it well in check. A little of the arsenical poisons used in time will prevent injuries, especially in our nurseries, where the insect can become a decided nuisance.

FAMILY PTEROPHORIDÆ OR FEATHER-WING MOTHS.

This is a very interesting little family of small slim moths, which are distinguished by having long slender legs and long narrow fore-wings split into lobes, feathers or plumes. Occasionally the fore-wings have only one cleft or fissure which does not extend beyond the middle, but sometimes they are split their full length. The hind-wings may be divided into from four to six lobes or feathers. As a general rule these insects are not very common or infest wild plants; some, however, can become quite injurious to cultivated ones. It is strange how rapidly insects of all kinds will increase in numbers if food is abundant and enemies scarce. We had an interesting case near the Experiment Station some years ago. A good many new streets were opened and the soil taken from them, in most cases clear sand, was thrown upon some low lots with the view of raising them to the level of the street. Upon this sand nothing would grow for two seasons but the common thistle, which flourished, however, to such an extent as to form an impenetrable wilderness. About the time that the first flowers were ready to expand all the terminal branches of the plants died and it was found that each branch was inhabited by a single caterpillar of a feather-winged moth. The thistles, however, recovered, and each plant sent out a number of new branches, which produced a large number of flower buds; they were also destroyed by a second generation of these moths, which in turn were killed by parasites, so that after all the plants succeeded in producing numerous seeds but very much later than usual.

THE RASPBERRY PLUME.

(*Oxyptilus tenuidactylus* Fitch).

This is a very beautiful little moth and by no means very uncommon. It measures about an inch across the expanded wings. The head and thorax are dark tawny-brown with a tinge of coppery-red; the posterior part of the thorax is white. The fore-wings which have a deep brownish or coppery color with a metallic lustre and a few short silvery-white lines, are cleft down the middle about half their depth; this division, as well as the outer edge, is fringed The hind-wings, which resemble the fore-wings in color, are cleft into three parts, of which the posterior one is almost linear; all are deeply fringed. The antennæ are ringed with silvery-white, and spots of the same color are also found upon legs and body, the latter having the same color as the wings. When at rest the wings are closed in a very peculiar fashion.

The caterpillars of this moth are found full grown towards the middle of June; they are then about four-tenths of an inch long, of a pale yellowish-green color, streaked with pale yellow, and with transverse rows of shining tubercles, from each of which rise from two to six spreading hairs of a yellowish-green color. The small head is pale green, with a faint brown dot on each side. The caterpillar spins a loose web between leaves, and in it changes to a pupa, which is suspended somewhat like the chrysalis of diurnal butterflies, which it also resembles, not being rounded as are most of the pupæ of moths but being quite angular. It is less than three-tenths of an inch long, pointed behind, enlarging gradually towards the front, where near the end it slopes abruptly to the tip. It is of a pale green color, with a darker green line along the back, margined on each side with a whitish ridge; the pupa is more or less hairy. Before the perfect insect escapes the pupa gradually assumes a darker color. The insect is shown in Fig. 207.

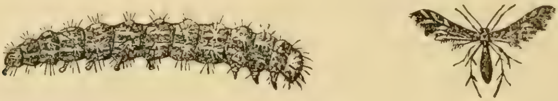


Fig. 207.—*Oxyptilus tenuidactylus* Fitch. After Saunders.

At present this insect, which feeds also upon the blackberry, is not common enough to cause injury.

THE GARTERED GRAPE PLUME.

(*Oyptilus periscelidactylus* Fitch).

This moth is sometimes quite abundant, and has elsewhere caused some injury to the foliage of the grape-vine. The caterpillars appear very early in spring, or as soon as the leaves unfold; they have the bad habit of fastening together the terminal leaves into a large ball, within which they live, feeding upon the tender leaves and young bunches of flowers. This habit causes the caterpillars to do considerable damage, but when we investigate the case more thoroughly we find that after all this is not so great since in most cases they do not commence operations until the clusters of flowers are already too large to be enclosed in the web, hence are not always eaten. The insects reach their full size quite early, giving the damaged shoot an opportunity to send out a new spur from the last leaf, so that the effects from the presence of the worm are scarcely noticed afterwards. In June the worms reach their full size, when they are about half an inch in length, of a yellowish-green color, with transverse rows of dull yellow tubercles, from each of which arises a small tuft of white hairs. Owing to these tufts of hairs the caterpillars resemble those of some "Woolly Bears." A line along the back is of deeper green, and the body is paler between the segments. The small yellowish-green head has a black band across the front; the feet are black, tipped with pale-green; the long and thin prolegs are greenish. As soon as mature

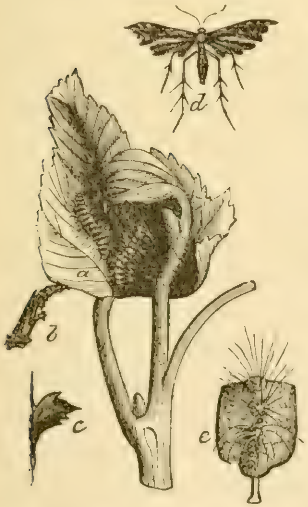


Fig. 208.—*Oyptilus periscelidactylus* Fitch. *a*, caterpillars; *b*, pupa; *c*, peculiar horn on back of pupa; *d*, moth; *e*, one segment of caterpillar. After Riley.

the worm spins a few silken threads on the under side of a leaf, or in some other sheltered spot, and having entangled its hind-legs firmly in this web of silk it sheds its hairy skin and becomes a pupa, which is a very odd looking affair, about four-tenths of an inch long, very angular and rugged, and most decidedly active if touched. It possesses on the middle of the back two rather long and compressed horns placed side by side, and extending upwards; other projecting points and ridges are also found. Its color is pale yellowish-green. After remaining in this condition for about two weeks it gives forth the perfect insect. Fig. 208 shows this insect in its different states.

The moth, expanding about seven-tenths of an inch, is a very pretty insect; it has long and narrow fore-wings, cleft down the middle about half way to their base, the posterior half of the wing possesing a notch in the outer margin. Their color is yellowish-brown, with a metallic lustre and several dull whitish streaks and spots. The hind-wing is colored in a similar manner, and is divided into three lobes; the lower division is complete, extending to the base; the upper one not more than two-thirds of the distance. All margins of the wings, including those of the lobes, are bordered with a broad whitish fringe, sprinkled here and there with brown; the long and slender body is a little darker than the wings; the moderately long and thread-like antennæ are nearly black, beautifully dotted with white throughout their whole length. The legs are long, alternately banded with yellowish-brown and white, the posterior ones ornamented with two pairs of diverging spines, which possess at their base a garter-like tuft of long brown scales.

The moth produces but one annual generation, hence is not very difficult to keep in check by picking off the infested tips, or by crushing the caterpillars within the webbed leaves.

SUPER-FAMILY TORTRICINA OR BELL-MOTHS.

These moths are generally small, with broad fore-wings usually squarely cut off. The front margin of the wing curves forward very strongly near the base of the wing, and at rest the broad fore-wings fold above the body like a roof. The wings are usually of the color of the body and frequently without markings. Most of the caterpillars, which, however, vary greatly in habits, are leaf-rollers, and this habit suggested the name "Tortrix." The leaves are rolled together in various ways, and are not simply used as shelter but also as food, and in many cases such a leaf is at first the nest for an entire brood of caterpillars.

THE FAMILY TORTRICIDÆ OR TYPICAL LEAF-FOLDERS.

Considerably more than one hundred different kinds of our moths belong to this family. Most of their caterpillars are decidedly injurious and not a few are found upon our fruit-producing plants.

THE CRANBERRY LEAF-FOLDER.

(*Teras oxycoccana* Pack.).

Only a single specimen of this insect was found near Park Rapids, showing, however, that the moth exists in our state, perhaps in large numbers. If the growing of cranberries in our numerous bogs, some of which are well adapted to this purpose, should become much more of a business than it is now there is but little doubt that this insect will prove destructive. It is a small moth, spreading nearly three-fourths of an inch across the wings, with uniform reddish-brown fore-wings with a peculiar silky lustre; the red tint is caused by scattered bright-red scales. The hind-wings are glistening gray; the body is of a dark slate color, with a pale tuft of hairs at the tip of the abdomen.

Prof. John B. Smith who has studied very closely the insects infesting the cranberries, has come to the conclusion that by keeping the bogs covered with water until after the middle of May, thus compelling the moths to deposit their eggs on other plants belonging to the same natural family, the intelligent cranberry-grower can prevent or greatly lessen the damage done by this and allied insects.

THE LESSER APPLE LEAF-FOLDER.

(*Teras minuta* Rob.).

This insect occurs sometimes in great numbers and is consequently injurious to apple-trees, especially the younger ones, or those still in the nursery, and causes them to look as if scorched by fire. The caterpillars are small greenish larvæ, smooth, with pale brown heads and whitish markings. They appear early in spring, and by drawing together the still tender leaves with silken threads they form a sort of protecting roof over themselves, which serves both as a shelter and as food. The second brood does not form this protecting shelter, but simply constructs a web over the surface of the leaf. The full grown caterpillar eats off the upper cuticle of a portion of a leaf, and then brings the edges together, tying them with silken threads, so as to form a snug little retreat lined with white silk, inside of which it changes to a brown pupa, about three-tenths of an inch long. Some segments of the pupa are furnished with minute spines and the posterior

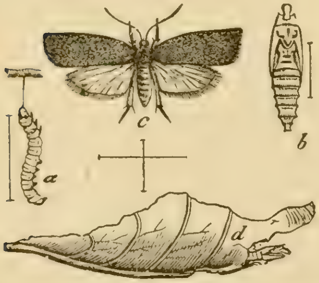


Fig. 210. — *Teras minuta* Rob.; *a*, caterpillar; *b*, pupa; *c*, moth; *d*, empty pupal skin projecting from folded leaf. After Riley.

extremity has two hooks bent downwards; by means of spines and hooks it works itself half way out of the retreat before the escape of the moth. See Fig. 210, *d*.

The moth has the head, thorax and fore-wings of a bright orange color; the hind-wings, body and legs are whitish, with a silken lustre. The moth expands about half an inch across the wings.

The first brood appears very early in spring, in time to deposit their eggs on the young and just unfolding foliage; the second brood is common during the latter part of July.

PACKARD'S YELLOW CRANBERRY WORM.

(*Teras vaccinivorana* Pack.).

This is considered a variety of the above insect. It is a very common insect in the eastern cranberry bogs and may also occur in Minnesota. The caterpillar of this insect draws the leaves of the cranberry together with silken threads, and feeds upon their upper surface; it is pale yellow, with a slight greenish tinge, with a few fine, long, pale hairs arising from prominent tubercles.

THE GREEN APPLE-LEAF TYER.

(*Teras minuta var. cinderella* Ril.).

This is considered as being simply a slate-colored variety, but sufficiently well-marked to deserve a name. Its fore-wings are of a glossy dark ash-gray color; the hind-wings are a little paler.

The small caterpillar, which is yellowish-green, with a horny head and neck of a deeper yellowish color, has a crescent-shaped black mark upon the former. Like all leaf-rollers or leaf folders it draws together the edges of a leaf and lives within the fold. It is a very active and minute worm.

which wriggles quickly out of its case and drops to the ground as soon as disturbed.

All these insects are rather difficult to exterminate on account of their method of living in protecting folds, but repeated spraying at the proper time with arsenical poisons will prove successful.

THE OBLIQUE-BANDED LEAF-ROLLER.

(*Cacœcia rosaceana* Harr.).

This is a very common insect found upon the apple, plum, cherry, rose, raspberry, gooseberry, currant, strawberry and other plants. In some seasons it is decidedly injurious, and many complaints are made, especially by lovers of the rose, whose pets are disfigured by the presence of such worms. When mature they are about three-quarters of an inch long, of a pale-green or yellowish-green color, but sometimes reddish or brownish, with head and cervical-shield brown; there is usually a darker green stripe along the back, and a few smooth dots on each segment, from each of which arises a short fine hair. The young caterpillars appear as soon as the buds of the apple-tree begin to unfold; they roll up and fasten together the still tender leaves which furnish them both shelter and food. When mature the caterpillar prepares its old dwelling place into a safer retreat by lining its inside with silk; it now changes to a pupa of a dark-brown color, from which issues towards the end of June or early in July the winged insect, shown in Fig. 211, Plate VIII.

This and a few other closely allied moths are characterized by a peculiar form; when their wings are folded they are short, broad and flat insects, resembling bells in outline; the expanded wings are very much arched on the front edge, curving in a contrary direction near the tip. The body of the moth is reddish-brown, the fore-wings of a light cinnamon-brown crossed with wavy darker brown lines, and with three broad, oblique, dark-brown bands, one of which covers the base of the wings and is sometimes indistinct or wanting; the second crosses the middle of the wings, and the third, which is broad on the front edge and narrow behind, is near the outer hind margin. The hind-wings are ochre-yellow, with the folded part next to the body blackish. The moth expands nearly an inch across the wings; it varies considerably in color, but the description given will fit the majority.

Besides eating the foliage the caterpillars are also very fond of the skin of the young apple, and the spots abraded by them soon change to a brown and rusty color, or crack open. The injury caused by these worms is sometimes greater than is warranted by their size, especially if they have selected the terminal branches of a tree for their home; in this case the growth of the branch is checked for quite a long time.

Notwithstanding the fact that the leaf-rollers form hollow cylinders firmly fastened together with silken threads, or other equally snug quarters as a protection against birds and other enemies, they are readily found by a number of parasites. The Baltimore Oriole, with its pointed beak, rarely makes a mistake in finding the worm, and in most cases the first attempt to pick up the hidden insect is successful, as shown by the single perforation found in such leafy cylinders.

Hand-picking done early in the season is always a good and safe remedy, but can only be done in small orchards with low-growing trees. If the insect becomes at all numerous we should spray the trees with arsenical poisons.

THE ROSE LEAF-FOLDER.

(*Cacœcia rosana* Linn.).

This common leaf-roller, found both in Europe and the United States, feeds also on the apple, wild-rose, raspberry, hazel, hawthorn, currant, gooseberry and other plants. It has not yet been found in Minnesota, but may occur here.

THE CHERRY-TREE LEAF-FOLDER.

(*Cacœcia cerasivorana* Fitch).

Caterpillars of this insect are frequently exceedingly numerous, not alone on the wild cherries but on the cultivated ones as well. As long as they are still young they are not readily detected, but as they grow older they draw together with silken threads the leaves and twigs of the infested plant, and in this manner form a very large and unsightly nest. The caterpillars, which are gregarious in their habits, feed inside these enclosures; they are about five-eighths of an inch long, nearly cylindrical, and have a black head; the body is yellow above and a little paler between the segments, and is covered with a few very fine yellowish hairs. The anterior portion of the second segment and the posterior portion of the terminal one is black; there is also a faint dorsal line of a darker shade; the under side is similar to the upper in color and the six true claw-like feet are black. The caterpillars change to pupæ inside the nest, and these latter, when about to give forth the moths, work their way out and hang suspended from the outer portion of the nest, clinging to it only by the hooks at the tail end of their bodies. Here the winged insects emerge, leaving the empty pupal skins projecting from the web. The pupa is of a pale brown color. The moths vary greatly in size, ranging from our-fifths of an inch to one and one-fifth inches across the expanded wings. These latter are broad and flat, the outer edge of the fore-wings being rounded towards the base, and straight from the middle to the tip; they are crossed by irregular wavy bands, alternately of bright ochre-yellow and pale leaden blue; the yellow bands are varied with darker spots, the most conspicuous of which is placed on the outer margin of the tip, and from this spot a broader ochre-yellow band extends towards the hind angle, and curves thence to the inner angle; the hind-wings and entire under surface are pale ochre-yellow. This moth is shown in Fig. 212, and also on Plate VIII.

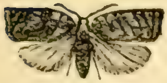


Fig. 212.—*Cacœcia cerasivorana* Fitch.

There are seasons in which these caterpillars are so numerous that whole trees, especially the smaller varieties of wild cherries, are entirely enclosed by several united webs, and all leaves are eaten, so that frequently nothing is left but a few cherries, which, however, shrivel before long. If numerous the unsightly webs should be removed with their occupants and should be burned. Any application with arsenical poisons would be useless at this time, as the leaves could not well be reached on account of the web enclosing them.

THE CRANBERRY LEAF-ROLLER.

(*Cacœcia paralella* Rob.).

A few of these insects were observed during the middle of June in a swamp near St. Anthony Park, and a closer inspection showed that a number of cranberry plants were webbed together. The caterpillars were about three-fourths of an inch long, reddish, with yellow heads, and a number of very prominent warts upon their backs; from each one of these tubercles grew one or more rather long and stiff hairs. None of these caterpillars pupated in confinement, but as they agreed very well with the description given by Prof. Smith, there is little doubt that they were the young of this insect.

The moth (Fig. 213) has reddish-orange fore-wings, crossed diagonally by numerous fine lines of a darker red-brown. There is also a broad, oblique, red-brown band across the middle of the wing, and a second of the same color extends to its tip, forming a triangular apical space; it is itself crossed by still darker brown lines; the hind-wings are pale yellow.

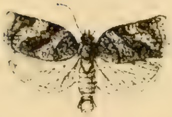


Fig. 213.—*Cacœcia paralella* Rob.

THE V-MARKED CACŒCIA.

(*Cacœcia argyrospila* Walk.).

This is also a common species which flies towards the end of June. Its caterpillar is a very general feeder, being found upon the rose, hickory, apple, oak, maples, elm, cherry, and even upon such plants as vetches. The colors of the moth vary considerably, but are usually a shining, pale, lemon-yellow, with a basal patch, central fascia and large costal spot rich, dark, velvety-brown. The spaces between the ordinary markings are clouded and speckled with dark brown, intermixed with ochraceous scales; fringes pale ochraceous. The hind-wings are dark fuscous. (Fig. 214, Plate VIII).

THE HICKORY LEAF-ROLLER.

(*Lophoderus juglandana* Fern.).

This insect has once been found flying among some young hickory and black walnut trees, and as it is known to be injurious to these plants, it is best to give a short description of it. The whole insect, with the exception of the lower wings, which are of a fuscous color, is dark reddish-brown; each of the fore-wings has two oblique, narrow bands of darker brown, and in the male there are scattered a few scales of straw-yellow color, especially along the borders of the oblique bands.

THE APPLE LOPHODERUS.

(*Lophoderus triferana* Walk.).

This leaf-roller occurs on the apple, rose and on many other plants; it is very much smaller than *juglandana*. The fore-wings are pale reddish-brown within the central fascia; the internal margin is broadly covered at base with blackish-brown scales forming a rather prominent irregular spot. The central fascia is broad, distinctly dark-brown, sometimes reddish-brown. The sub-apical costal spot is dark-brown, and separated from the central fascia by a reddish-brown shade. The remaining outer portion of the wing is pale ochreous except a testaceous-brown spot above the anal angle; fringes dark ochreous.

THE RUSTY-BROWN TORTRIX.

(*Platynota flavedana* Clem.).

This insect feeds in its larval state upon the strawberry, raspberry, red and white clover. It is not very common, but is found from time to time in fairly large numbers, showing that it can under favorable conditions become injurious. The full grown caterpillar is about half an inch long, of a dark yellowish-green color, with the piliferous tubercles a little lighter and faintly polished. Head and thoracic-plate are reddish, first joint and anterior margin of the thoracic segment white; the anal-plate is concolorous with the body, sometimes a little lighter. There are three dusky spots near the anterior margin of the anal-plate; the tip of the segment has eight short and stiff bristles, and the whole body is covered with minute brown granulations. Early in September these caterpillars change to brownish pupæ with the usual short spines on the edges of the dorsal side of the abdominal segments. Soon afterwards the moths appear, of which the sexes differ considerably. The males are of a dark-brown color over the larger part of the fore-wings, with minute tufts of scales over the surface; the outer portion and base of the wings are reddish-yellow; the hind-wings are dull rust-red. The females are dull rust-red, the fore-wings with three oblique bands across them, nearly obliterated in places. The expanse of wings in the male is five-eighths of an inch, that of the female three-fourths of an inch. (Fig. 217).

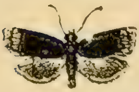


Fig. 217.–*Platynota flavedana* Clem.

THE SULPHUR-COLORED TORTRIX.

(*Dichelia sulfureana* Clem.).

The caterpillars of this insect are rather general feeders; they are also found upon the leaves of the grape and the strawberry, which they draw together. Their home is most frequently arranged in such a manner that it forms a tube, open at either end; they feed upon the surrounding foliage, of which they devour only the under surface as long as they are still small, but later they eat irregular holes. Like most of such larvæ they are very active and escape from their tubes by suspending themselves by a silken thread, by which they can let themselves down to the ground and reascend to their shelters. The cylindrical caterpillar is slightly fusi-form; head and thorax are very pale honey-yellow, the rest of the body is yellowish-green with the ali-

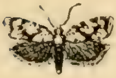


Fig. 218. — *Dichelia sulfureana* Clem.

mentary canal showing dark green through the dorsum. The piliferous tubercles are slightly paler than the rest of the body, and each one is surmounted by a brownish hair. The spiracles are green with a brown ring. Most of the caterpillars transform early in July to pupæ of a dark shining brown; the moths issue soon afterwards. They are of a beautiful bright-sulphur and golden-yellow color, with a Y-shaped purplish red mark across each fore-wing, and more or less of the same color along the front border. They measure with expanded wings about half an inch across. Fig. 218.

FAMILY GRAPHOLITHIDÆ OR GRAPHOLITHIDS.

These moths are readily distinguished from the other Tortricids by the presence of a fringe of long hairs on the basal part of the cubitus of the hind-wings. Nearly two-thirds of all our species of Tortricids belong to it.

THE GRAPE-BERRY MOTH.

(*Eudemis botrana* Schiff.).

This insect was imported many years ago into this country from southern Europe where it is very injurious. It is now very widely distributed in the United States, occurring probably wherever the grape is cultivated to any extent. It attacks all varieties of grapes, but is especially destructive to those with tender skinned berries or which grow in compact bunches. It feeds also upon a number of other plants and can become such a very injurious pest that it has been known to destroy as much as 50 to 75 per cent. of a crop. In the more southern states it produces three annual generations, but only two farther north. The first brood of it is but rarely noticed, and no protective steps are taken; later in the season it can multiply with great rapidity, when it is apt to become decidedly injurious to the grapes maturing late.

The young caterpillars injure the berries early in July, when the infested fruit shows a discolored spot where the larva has entered. When we open the berry we generally find in the pulp a long and thin larva of a whitish-green color. Besides feeding on the pulp it sometimes eats portions of the seeds, and if the contents of a single berry are not sufficient two or more are drawn together by means of silk, mixed with castings. Such injured berries begin to appear while the fruit is young and green, but they increase in numbers as they ripen. Infested berries resemble very much those that are afflicted by a disease called the Black Rot. The young larva is about an eighth of an inch long, has a black head and a blackish cervical-shield; its body is dull whitish or yellowish-green. It is always very active and is apt to wriggle out of the grape and escape. When full grown it is about one-third of an inch long, and is now olive-green or dark-brown. At this time it abandons the berry, and now cuts out of the grape-leaf a little flap, which it folds over and fastens with silk, thus forming a small oblong case, in which it changes to a yellow or yellowish-brown pupa. Sometimes the larva simply rolls over a piece of the edge of a leaf and thus forms a retreat, which it lines with silk. The moth measures with expanded wings nearly

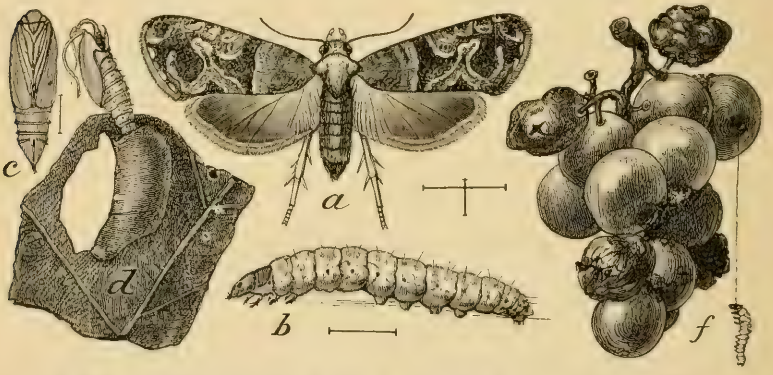


Fig. 219.—*Eudemis botrana* Schiff.; *a*, moth; *b*, larva; *c*, pupa; *d*, case with empty pupa, all enlarged; *f*, grapes with worm natural size. From Div. of Entomology, Dep. of Agriculture.

four-tenths of an inch across. Its fore-wings are of a slate-color, or of a pale dull bluish shade, with a slight metallic lustre, and ornamented with dark reddish-brown bands and spots; the hind-wings are dull brown, deeper in color towards the margin; the body is greenish-brown. The last generation of larvæ remains in their leaf-cases through the winter, and emerges early in the spring. This, the first brood of caterpillars, feeds upon the leaves, tendrils and blossoms of the grape, there being not yet any berries to enter. All states of this insect are shown in Fig. 219.

Mr. Marlatt writes in one of the late bulletins of the Div. of Entomology that: "the use of poisons is not practicable except against the first brood, which develops on the green part of the vine, and here the result is doubtful, because it is more than likely to breed on a great variety of foliage and spraying would not afford much protection. Bagging the grapes as soon as the fruit sets will undoubtedly protect them from this insect, and at the same time from Black Rot. Of greater practical value, especially in larger vineyards, is the prompt collection and burning of all fallen leaves in autumn, thus destroying the hibernating larvæ and pupæ, and also the collection and destruction of diseased fruit wherever feasible. Early gathering and shipping or disposal of fruit otherwise is a particularly valuable step, as it insures the removal of the larva in the grapes from the vineyard if not their destruction in wine making. All fallen fruit should also be gathered and destroyed."

THE APPLE BUD-WORM.

(*Exartema malana* Fern.).

This insect has been quite injurious in northen Illinois, where the young caterpillar after devouring the bud, fastens the leaf-stalk of one of the leaves growing near the tip to the side of the branch, and thus forms a sort of tunnel between the leaf-stalk and the branch, in which it finds a shelter during the day, issuing from it at night to eat the leaf so secured. It is stated that if it has eaten this leaf it also devours the newly formed wood, even burrowing for a short distance into the twig. The tips of the infested twigs usually die back as far as the base of the first perfect leaf, where a new bud forms, which soon assumes the position of the one destroyed. As this new bud is late in starting, and never grows straight, the injury caused by these small worms interferes seriously with the growth of the trees, and also mars their beauty. As long as young the caterpillar is pale greenish or yellowish-green, sometimes tinged with pink on the back. It has a yellowish head, with a black dot on each side; the cervical-shield is also yellowish. When full grown it measures about half an inch in length and it is now of a dark flesh color; its body is marked with a number of small shining spots, and the head and horny cervical-shield are black. When about full grown it deserts the tunnel on the twig and constructs a yellow woolly tube or case upon one of the leaves, in which it lives, issuing at night to feed upon the neighboring leaves; if it has to move it drags its case along. Soon afterwards it closes the house with a silken door and tranforms inside to a pupa, from which the moth issues in about ten days.

There is but one annual brood of this insect. Its fore-wings are white, mottled and spotted with greenish-brown; there is a large grayish-brown spot at the tip, mottled with white, and another towards the base of the wing, of a darker shade; the front edge is mottled with grayish-brown; the hind-wings are dusky.

The insect has as yet not been found in our state, but very likely it has been over looked. It can be kept in check by the proper use of Paris-green or London-purple mixed in the proportion of one teaspoonful of the poison to two gallons of water. Hand-picking is also a great help, and most of these insects can be gathered while still in their burrows near the tip of the twigs. Wherever the spraying of orchards is practiced the insect can not become very numerous and destructive.

THE RASPBERRY LEAF-ROLLER.

(*Exartema permundana* Clem.).

This insect has received a number of other popular names, which indicate its food habits; it is called in southern New England the *Hickory Exartema*, because it feeds on the leaves of the hickory. Prof. Saunders calls it the *Neat Strawberry Leaf-roller*. He says: "This pernicious little caterpillar appears just about the time that the strawberry blossoms are opening, and delights to form its protecting case by drawing the flowers and flower-buds together into a ball, and to feast upon their substance, a peculiarity which renders its attacks much more injurious than any mere consumption of leaves would be. The larva is of a green color; with the head and upper part of the next segment black. When full grown it is about five-eighths of an inch long, is very active in its habits, and wriggles itself quickly out of its hiding place when disturbed. Late in June or early in July it changes to a brown chrysalis, from which in a few days the perfect insect escapes.

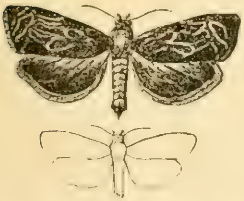


Fig. 221. — *Exartema permundana* Clem. After Saunders.

"The moth which is shown magnified in Fig. 221, has its fore-wings yellowish or greenish-brown, varying much in shade of color, with irregular lighter markings crossing the wings obliquely; the hind-wings are ashy-brown.

"The caterpillar is very destructive in some districts, and feeds upon the wild strawberries as well as on the cultivated varieties."

Dr. Packard says that "from eggs laid the previous autumn on the twigs of hickories, the insect being probably double brooded, the caterpillars hatch out simultaneously with the opening of the leaves in spring, living about a week or ten days in this state between the folded leaves or rolling them up sideways or from the apex to the base; in the fold or roll thus made, which it lines with silk, it changes to a chrysalis, remaining about a fortnight in this state until in the third week in June, in southern New England, it appears as a beautifully marked moth flying about and resting on the leaves."

The caterpillars of this insect are rather general feeders, being found, besides on the plants already mentioned, upon the Siberian crabapple, raspberry, wild and cultivated blackberry, hazel-nut and Spiræa,

THE CRANBERRY-WORM.

(*Rhopotota vacciniana* Pack.).

Wherever this insect is common it causes great injury to the foliage of the cranberry vines and on that account is frequently called the "fire-worm." It has not been reported from our state, but doubtless occurs here. The moth (Fig. 222) is of a dark ash-color; the fore-wings are whitish, dusted with brown and reddish scales, with narrow white bands on the front edge, alternating with broader yellowish-brown bands, five of which are larger than the others, and from four of these, distinct but irregular lines cross the wings. The tips of the fore-wings are dark-brown and very pointed; the hind-wings are dusky gray. In the cranberry bogs of New Jersey they are very numerous during the month of June, when eggs for a second generation

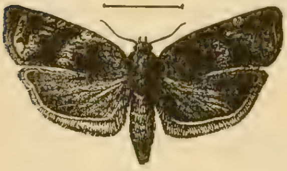


Fig. 222.—*Rhopotota vacciniana* Pack.

are deposited, the caterpillars of which appear early in July, succeeded by the perfect insect, which deposits the eggs that remain dormant until the following spring.

The caterpillar is green, with a few hairs scattered over the surface of its body. Like other leaf rollers it feeds upon the tender growing shoots, drawing the leaves together, fastening them with silken threads and concealing itself within the enclosure. As soon as full grown it spins a slight cocoon, either among the leaves on the vine or among leaves and rubbish on the ground, and there changes to the pupal state, which lasts from ten to twelve days.

All cranberry insects can be largely destroyed by flooding the bogs at the proper time; the vines should be kept under water for two or three days, which will kill all insects reached by it. Where this remedy can not be applied we have to use the arsenical poisons.

THE APPLE LEAF-SEWER.

(*Phoxopteris nubeculana* Clem.).

This oddly marked moth (Fig. 223) is white, with brown markings. It deposits its eggs in June, and the caterpillar is found throughout the summer and autumn on apple leaves.

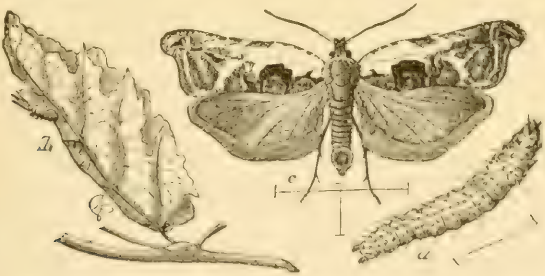


Fig. 223.—*Phoxopteris nubeculana* Clem. After Riley.

Like all leaf-rollers it folds the leaves together so that the edges meet, thus forming of the whole leaf a hollow case, inside of which it hides and feeds. The caterpillar is greenish-yellow, with a yellow head and a little darker horny cervical-shield, with a black dot on each side. On each of the remaining segments are a number of pale, shining, raised dots, from every one of which arises a single hair. As soon as the worms are full grown, on the approach of winter, they line their shelters with silk and fall with the leaf to the ground; they do not change to a pupa, which is yellowish-brown, until early in the following spring. When the enclosed moth is ready to emerge the pupa wriggles its way through the partly decayed case and thus gives the moth a chance to escape.

This insect is by no means a stranger in our orchards and nurseries and it has been known to become so numerous as to seriously injure the foliage of apple-trees. The burning of all leaves and other rubbish is in this case also an excellent remedy.

THE STRAWBERRY LEAF-ROLLER.

(*Phoxopteris comptana* Froel.).

This is the Strawberry Leaf-roller par excellence, though other leaf-rollers also attack the leaves of this plant. This insect is sometimes very common, causing in some seasons considerable damage The moth appears early in July; it has reddish-brown fore-wings, spotted with black and white; the hind-wings are dusky, the head and thorax reddish-brown. It measures with expanded wings nearly half an inch across. The eggs for a second brood are deposited during the latter part of July, and the resulting caterpillars are full grown towards the end of September, when they pupate. They hibernate in this condition, and produce moths the following spring.

The caterpillars roll the leaves into cylindrical cases, secured by threads of silk; they feed inside these shelters and cause the leaves to become discolored and to wither. They reach a length of about one-third of an inch, and vary in color from yellowish-brown to dark-brown and green. Their heads are horny, of a yellowish color, with a dark, eye-like spot on each side. The cervical-shield is colored and polished like the head; on every other segment are a few pale dots from each of which arises a single hair. The insect is shown in Fig. 224.

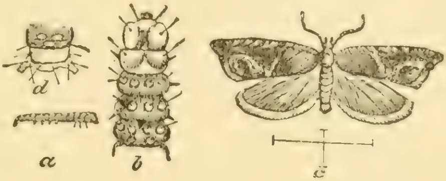


Fig. 224.—*Phoxopteris comptana* Froel. After Saunders.

The best remedy against this pest is to mow the plants and to burn them as soon as the fruit has been gathered. In replanting we should be careful and select only plants from districts not infested with such injurious worms.

THE APPLE BUD-MOTH.

(*Grapholitha prunivora* Walsh).

This insect, which infests not alone the apple, but also the plum and cherry, is not common in our state, and it is a good thing for our fruit growers that such is the case, as it can become decidedly destructive by eating the buds of apples before they expand, thus causing much more injury than if the leaves themselves were eaten. The larvæ of this insect has also the bad habit of feeding inside cherries, which usually drop in consequence.

THE CODLING MOTH.

(*Carpocapsa pomonella* Linn.).

It may seem that a discussion of this insect is not necessary since it has received such very extensive attention at different times, and especially within the last few years. The discovery of a method of protecting orchards from their ravages, however, only make it more desirable that the life-history of the insect should be known in order that the remedies may be properly applied.

The insect is double-brooded in most of the apple-growing regions. The adult moth issues from the pupal stage shortly after or about the time of blossoming of the fruit trees, and deposits its eggs in the calyx of the newly forming apple. It has been shown, however, that in some cases the egg may be deposited elsewhere, even upon leaves. Soon after hatching the larvæ enter the fruit and attain their growth within, becoming mature about the first of July, when they leave the apple and seek a shelter such as crevices in the bark or rubbish on the ground in which to transform.

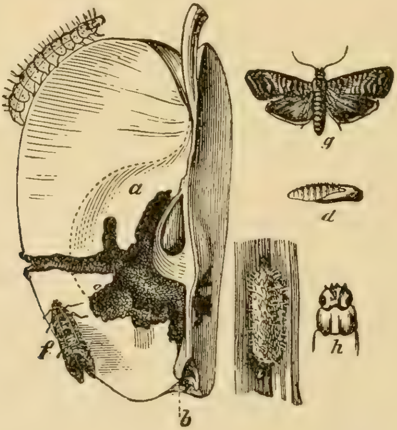


Fig. 226.—*Carpocapsa pomonella* Linn. After Riley.

They pass through the pupal state in about two weeks, and the moths issuing about this time deposit eggs for the second brood. The worms developing from these are found in the fall and early winter. Upon leaving the apple these larvæ form their cocoons in the cracks of barrels and bins, or near places where the apples are stored.

The most successful method yet found of destroying these insects consists in spraying the trees with a poisonous solution shortly after the fall of the apple blossoms; its success depends upon the poison being retained within the calyx of the apple until the time of hatching of the larvæ, and upon these obtaining for their first food some of the poison thus retained. For this spraying London-purple is in some respects the most satisfactory material and should be used at the rate of one and one-half pounds to one hundred gallons of water; it becomes more efficient if a small portion of soap or flour has been mixed with it. The powder should be first made into a batter, after which it may be mixed with the full quantity of water required. The spraying should be done with a force-pump and a nozzle which will give a fine mist that will settle upon all parts of the tree, and should be continued until the leaves begin to drip. Of the nozzles manufactured for this purpose there are several efficient forms, which may be secured from manufacturers or through hardware dealers. This spraying should be repeated within a few days if there has been a shower of rain and it is considered wise to spray a second time eight or ten days later even if there have been no showers.

It has been determined by careful experiment that nearly seventy per cent. of the fruit that would otherwise be infested can be kept free of the worms by the use of this method; and considering its cheapness and the ease with which it can be applied even in large orchards it is worthy of general adoption.

Prof. Saunders in "Insects Injurious to Fruits," a book that should be in the hands of every fruit-grower, writes:

"This is one of the most troublesome insects with which fruit-growers have to contend, and although of foreign origin, having been imported from Europe about the beginning of the present century, it is now found in almost all parts of North America, entailing an immense yearly loss upon apple-growers.

"The early brood of moths appear on the wing about the time of the opening of the apple blossoms, when the female deposits her tiny yellow eggs singly in the calyx or eye, just as the young apple is forming; in a few instances they have been observed in the hollow at the stalk end, and occasionally on the smooth surface of the cheek of the apple. In about a week the egg hatches, and the tiny worm at once begins to cut through the apple to the core. Usually its castings are pushed out through the hole by which it has entered, the passage being enlarged from time to time for this purpose. Some of the castings commonly adhere to the apple, hence before the worm is full grown infested fruit may generally be detected by the mass of reddish-brown exuviæ protruding from the eye. Sometimes as the larva approaches maturity it eats a passage through the apple at the side, as shown in the figure, and out of this opening thrusts its castings, and through it the larvæ when full grown escape. The head and upper portion of the first segment of the young larva are usually black, but as it approaches maturity these change to a brown color. The body is of a flesh-color, or pinkish tint, more highly colored on the back; it is also sprinkled with minute, elevated points, from each of which arises a single fine hair.

"In three or four weeks from the time of hatching the early brood of larvæ attain full growth, when the occupied apples generally fall prematurely to the ground, sometimes with the worm in them, but more commonly after it has escaped. The larvæ, which leave the apples while still on the trees, either crawl down the branches to the trunk of the tree, or let themselves down to the ground by a fine silken thread, which they spin at will. In either case, whether they crawl up or down, the greater portion of them find their way to the trunks of the trees, where, under the rough bark and in cracks and crevices, they spin their cocoons.

"Having selected a suitable hiding place, the larva constructs a papery-looking silken cocoon, shown in the figure, which is white inside, and disguised on the outside by attaching to the silky threads small fragments of the bark of the tree or other available debris. After the cocoon is completed, the change to the chrysalis takes place in the early brood in about three days. At first the pupa is of a pale yellow color, deepening in a day or two to pale brown; the insect remains in this condition about two weeks, when the moth escapes.

"Each moth is capable of laying on an average probably not less than fifty eggs, but these are not all matured at once; by careful dissection they may be found in the body of the moth in different stages of development. Hence they are deposited successively, extending over a period of probably from one to two weeks or more; add to this the fact that some of the moths are retarded in their development in the spring, and it is easy to account for the finding of larvæ of various sizes at the same time; indeed sometimes the later specimens from the first brood will not have escaped from the fruit before some of the young larvæ of the second brood make their appearance, the broods thus, as it were, overlapping each other, and very much extending the period for the appearance of the winged insects.

"The moth, although small, is a beautiful object. The fore-wings are marked with alternate irregular, transverse wavy streaks of ash-gray and brown, and have on the inner hind angle a large, tawny-brown spot, with streaks of light bronze or copper color, nearly in the form of a horse shoe; at a little distance they resemble watered silk. The hind-wings and abdomen are of a light yellowish-brown, with the lustre of satin. The moth conceals itself during the day-time, and appears only at night, and, since it is not readily attracted by light, is seldom seen. The second brood of moths are usually on the wing during the latter half of July, when they pair, and in a few days the female begins to deposit her eggs for the latter brood of larvæ, generally selecting for this purpose the later apples. These larvæ mature during the autumn or early winter months; if they escape before the fruit is gathered, they seek some sheltered nook under the loose bark of a tree or other convenient hiding-place; but if carried with the fruit into the cellar, they may often be found about the barrels and bins in which it is stored; a favorite hiding-place is between the hoops and staves of the apple barrels, where they are found sometimes by hundreds. If thus provided with winter quarters and through negligence allowed to escape, the fruit grower must expect to suffer increased loss from his want of care. Having fixed on a suitable spot, the larva spins its little tough cocoon, firmly fastened to the place of attachment and within this it remains in the larval state until early the following spring, when it changes to a brown chrysalis, and shortly afterwards the moth appears, to begin the work of the opening season.

"Besides injuring the apple, it is very destructive to the pear; it is also found on the wild crab, and occasionally on the plum and peach. Sometimes two larvæ will be found in the same fruit.

"Remedies —One of the most effective methods yet devised for reducing the numbers of this insect is to trap the larvæ and chrysalids and destroy them. This is best done by applying bands around the trunks of the trees about six inches in width; strip of old sacking, carpet, cloth, or fabric of any kind will serve the purpose, and although not so durable, many use common brown paper. Whatever material is used it should be wound entirely round the tree once or twice and fastened with a string or tack. Within such enclosures the larvæ hide and transform. The bands should be applied not later than the 1st of June, and visited every eight or ten days until the last of August, each time taken off and examined, and all the worms and chrysalids found under them destroyed; they should also be visited once after the crop is secured. Some persons prefer to use narrower bands, not more than four inches wide, and fasten them with a tack, while others secure them in their place by merely tucking the end under. Usually the cocoons under the bandages are partly attached to the tree and partly to the bandage, so that when the latter is removed the cocoon is torn asunder, when it often happens that the larva or chrysalis will fall to the ground, and if it escape notice may there complete its transformations. Wide mouthed bottles partly filled with sweetened water, and hung in the trees, have been recommended as traps for the codling moth, but there is no evidence that any appreciable benefit has ever been derived from their use. A large number of moths can be captured in this manner, but it is rare to find a codling moth among them. Neither is the plan of lighting fires in the orchard of much avail, since codling moths are rarely attracted by light. Spraying the trees soon after the fruit has set, and while it is still in an upright position, with a mixture of Paris-green and water in the proportion of a teaspoonful to a pailful of water, will deter the moths from placing their eggs on the apples, and thus protect much of the fruit from injury.

"The fallen fruit should be promptly gathered and destroyed. It has been recommended that hogs be kept in the orchard for the purpose of devouring such fruit, and where they can be so kept without injury to the trees or other crops they will no doubt prove useful.

"This insect, while in the larval state, is so protected within the apple that it enjoys great immunity from insect enemies. Nevertheless it is occasionally reached by the ever watchful Ichneumons, two species of which are known to occur as parasites within the bodies of the larvæ. They have been bred by Mr. C. V. Riley, who describes them in his fifth Missouri Report. One is a small black fly, from one-fourth to one-half inch in length; its legs are reddish, the hind pair having a broad white ring. It is called the Ring-legged Pimpla, *Pimpla annulipes* Br. The other species is about the same size, but more slender, and of a yellowish or brownish color. The female is provided with a long ovipositor. This species is known as the Delicate Longsting, *Macrocentrus delicatus Cresson.* These useful insect friends are not yet sufficiently numerous to check materially the increase of the codling moth, and it is doubtful if they ever will be. When the codling worm has left the fruit in which it has been feeding, and while wandering about in search of a suitable spot in which to pass its chrysalis state, it is liable to be attacked by any of the Ground-beetles, (*Carabidæ*), both in their larval and their perfect state; also by the larva of Soldier-beetles and other carnivorous insects. Some of the smaller insectivorous birds are also said to devour this insect both in the larval and in the pupal condition."

THE EYE-SPOTTED BUD-MOTH.

(*Tmetocera ocellana* Schiff.).

This is also a very destructive insect, the larva of which eats into the opening bud of the apple, plum, cherry, blackberry and other plants. According to Prof. Fernald, who gave a full account of the life-history of this insect: "the moths pair and the female lays her eggs, when in confinement, in clusters of from four to ten or eleven, often overlapping each other. They are oval, flattened, four-fifths of a millimeter long, and half as wide, sordid white, with a narrow border of clear transparent white, while the center of the eggs is one complete mass of minute granules. In about three days the center of the egg has grown darker and the granules larger, and on either side there is a clear, white, oval space about one-third the length of the egg. In about two days more the outer edge of the center is of the same color as in the last stage, and inside this is a narrow, lighter band, while in the center is seen the form of a cylindrical larva larger at one end, and both ends slightly curved towards each other; and in one or two days more the whole form of the larva is visible, the head, thoracic and anal shield being black. The egg stage lasts from eight to eleven days.

"When the young larva hatches it does not eat the shell of the egg, but goes on to the tenderest leaves, and almost immediately begins spinning a microscopic layer of silk, under which it eats the outer layer or epidermis of the leaf. The larva is then about three millimeters in length, of a creamy-white color, with head, thoracic and anal shields blackish-brown, and a few minute pale hairs on the body; the head is very large for the rest of the body. In a week the larva is nearly four millimeters long, light yellowish-brown, with the head, thoracic and anal shields dark-brown, and it eats minute holes through the leaf, its silken web now being visible to the naked eye. The larva gradually becomes a trifle more brownish, increases in size and enlarges its web along the side of the midrib.

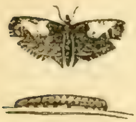


Fig 227.—*Tmetocera ocellana* Schiff.

"Late in fall the silken web is quite heavy and thick, and the larva deposits its excrements in little black pellets in the form of a tube under the web, within which it hibernates during the winter. Not unfrequently two leaves are fastened together by the silk of the web and sometimes a leaf is secured to a branch of the tree in the same manner.

"About the first of May the larva measures seven millimeters when resting, and eight when in motion. It is cylindrical in form, with the head dark brown and of medium size. The body is dark yellowish-brown, and the head, thoracic and anal shields very dark, polished brown. There are ten lighter brown protuberances on each segment, from each of which arises one pale hair. On the upper surface of the ninth segment is seen the double undeveloped reproductive organ of a light brown color. The legs are dark brown and the prolegs yellowish-brown. About the first of June the larva is from ten to twelve millimeters in length, and the body has changed to a cinnamon-rufous color. From the middle to the last of June it curls or draws together several leaves which it lines with silk, and in which it transforms to a pupa.

"The pupa is seven millimeters long, brownish-yellow, tapering from the head to the posterior end, with the wing-cases dark-brown. There are two rows of dark-brown spines pointing backwards, across each abdominal segment. The spiracles and anal segment are dark-brown. It remains in the pupa stage about two weeks and then the moth emerges.

"For some years past, I have observed the habits of this insect, and have been able to carry it through its transformations. The moths emerge between the last of June and the middle of July, though belated specimens are sometimes taken on the wing as late as the middle of August, and one was taken at this place August 25th, 1889.

"The fore-wings expand about three-fifths of an inch. The head, thorax, and basal third of the fore-wings, and also the outer edge and fringe are dark ash-gray, the middle of the fore-wings is cream-white, marked more or less with costal streaks. Just before the anal angle are two short, horizontal, black dashes followed by a vertical streak of lead-blue, and there are three or four similar black dashes before the apex, also followed by a streak of lead-blue.

"The hind-wings above and below the abdomen are ashy-gray. The underside of the fore-wings is darker, and has a series of light, costal streaks on the outer part.

"To destroy these caterpillars, it is desirable to gather all the leaves from under the infested trees in the fall and burn them, and also to shower the trees with one pound of Paris-green in one hundred and fifty gallons of water, in the spring when the buds first begin to swell."

Besides the Tortricidæ thus far described there are many others that are fond of the leaves of our cultivated fruits, but as all are similar in their modes of life, etc., it is not necessary to mention them, especially as the remedies that can be applied are also about the same.

SUPER-FAMILY TINEINA OR TINEIDS.

Tineids are all very minute moths, with narrow wings, bordered by wide fringes; only a few possess broader wings with narrow fringes. They are often very beautiful, their wings being covered with scales that shine like silver and gold, but their small size make it necessary to examine them with a lens to appreciate their beauty. Their larvæ feed usually upon or within the leaves of plants; others thrive within nuts, seeds and dried fruits; still others eat dead animal matter, as woolens, fur and feathers; while a few are predaceous, destroying scale-insects. Many species of such moths occur in the United States and nearly one thousand kinds have already been described. The work of most of the mining species is very characteristic, and it seems that each one infests only a particular species of plant, in the leaf of which it makes a mine of definite shape, by means of which an expert can determine the species that made it. There are few leaves in late summer and autumn that do not show the mines of different kinds of Tineids. When we study such mines we find that the little larvæ of the Tineids live until full grown between the two skins of a leaf, deriving their nourishment from the green parenchyma.

THE PALMER WORM.

(*Ypsolophus pomotellus* Harr.).

According to Fitch this insect is in the state of New York more or less common every year, making its appearance towards the middle of June. In some years it becomes very numerous, and as it is a very general feeder the green foliage of the trees infested can in a single day change to a withered brown hue, as if scorched by fire. As long as the worms are still young they eat only the green pulpy tissues of the leaf, leaving its net work of veins entire, but as they become larger they consume the whole of the leaf except the coarse veins. The young and tender leaves which grow at or near the tips, are preferred; the older and tougher ones are simply eaten at their tip ends, or have irregular holes of various sizes gnawed in them, some of these holes not being larger than a puncture made with a pin. The green and soft ends of twigs are also eaten. They enjoy eating either round holes or large irregular cavities into young apples, which soon afterwards wilt and drop to the ground.

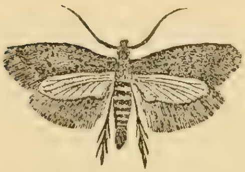


Fig. 228.—*Ypsolophus pomotellus* Harr. After Fitch.

The caterpillars vary greatly in color. When full grown they measure almost half an inch in length, and are commonly pale-green or yellowish-green; along each side of the back is a dusky stripe and above this a faint, whitish one, and on the middle of the back is another dusky stripe between the white ones. There are also several small black spots, arranged symmetrically, and each yielding a fine hair; the polished head is yellow. These caterpillars change to pale tawny-yellow pupæ in the same tuft of leaves in which they resided; they make but a very slight cocoon.

The moths also vary greatly in coloration but the usual color is ash-gray; the fore-wings are sprinkled more or less with black scales, and have on the apical edge at the base of the fringe six to seven equidistant black dots. On the disk are also four larger black or brown dots, two before and two behind the middle, the latter nearer together than the former. The moth is shown in Fig. 228.

There are two other species of Palmer Worms, both found occasionally in our orchards. These are the Comrade Plum Worm (*Ypsolophus contubernalellus* Fitch), and the Striped Palmer Worm (*Y. malifoliellus* Fitch).

In case these worms should become numerous they can be successively combatted by spraying the trees with any of the arsenical poisons; they are also readily dislodged by the use of whale-oil soap diluted with water.

THE STRAWBERRY ROOT-BORER.

(*Anarsia lineatella* Zell.).

This insect is not found alone on the strawberry plant, but is also very destructive to the twigs of a number of trees. In the Eastern States it has the bad habit of boring into the tender twigs of the peach tree, killing the terminal buds, and in the western states it invades the young plum trees in a similar way. In Europe it is also destructive to the peach. It is an insect that can become very destructive to the strawberry plants. Its caterpillar is only about half an inch long, reddish-pink, fading into dull yellow on the second and third segments; the cervical-shield is smooth, horny, and of the same brownish-yellow color as the head. A few shining and reddish dots are found on each segment, from each of which rises a single, fine, yellowish hair. The under surface of the worm is paler. It bores irregular channels through the crown of the plant, sometimes excavating large chambers; at other times it tunnels it in various directions. If we examine such cavites or tunnels in spring we will find in them a small, soft and silky case, almost filled with castings, which no doubt was the hibernating quarters of the worm. The caterpillars mature early in June, and transform into small reddish-brown pupæ, either inside the cavity of the crown of the plant or outside among decayed leaves or other rubbish.

The moth appears early in July; it is quite small, of a dark gray color, with a few blackish-brown spots or streaks on the fore-wings; the fringes on all wings are gray, tinged with yellow. Towards the end of July or early in August this moth deposits on the crown of the plant an egg which soon hatches. The small worm burrows at once into the heart of the plant, and after making a snug silken home it retreats into it for the winter. Both worm and adult are shown in Fig. 229.

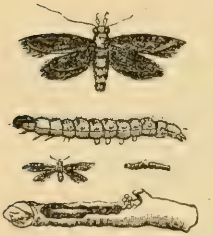


Fig. 229.—*Anarsia lineatella* Zell. After Saunders.

Many remedies have been proposed, but the only certain one is to dig up the infested plants and to burn them. If they infest trees these should be clipped as soon as the insects are discovered and the parts removed should also be burned.

It seems more than doubtful that the same insect should possess such different habits as eating into twigs of trees and boring into the crowns of strawberries, and closer investigation is needed to decide this question. Perhaps two species of insects resembling each other very closely cause these damages.

WILD CHERRY LEAF-MINER.

(*Ornix geminatella* Pack.).

The larva of this moth makes also a tentiform mine on the under surface of the apple leaves, eating the parenchyma, and forming a pupa at the edge of the turned up leaf in a silken cocoon. The cylindrical larva reaches a length of about one-fourth of an inch; it is grayish, with a light brown head and a light yellow first thoracic segment. On the dorsal surface of the rest of the body are four longitudinal rows of white elevations, each segment having at or near its middle one of these elevations in each row. Two similar rows of elevations are found on each side of the larva, and from each of these elevations arises a very long hair. Upon the back of the head are found conspicuous black spots; upon the cervical-shield are also larger black spots; the true legs are black on their outside while the inside is grayish. As soon as full grown the larva leaves the mine

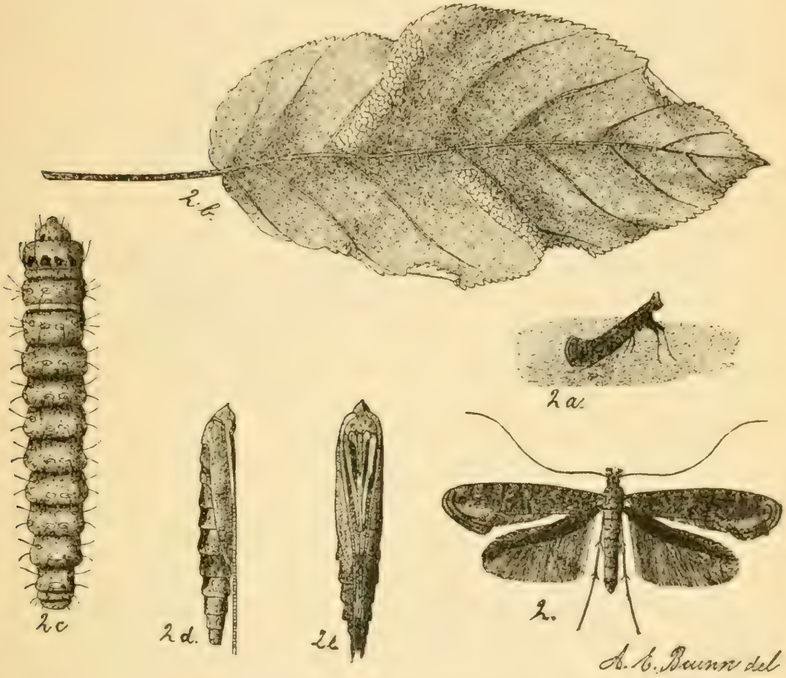


Fig. 230.—*Ornix geminatella* Pack. After Comstock.

through a small circular hole at one end, and folds the edge of the leaf over itself by means of silken threads and forms in this shelter a delicate silken cocoon. Here it changes to a pupa and hibernates. The pupa is brownish-yellow.

The moth is dark steel-gray, almost brown. The thorax and fore-wings are steel-gray, the latter with about nine faint, whitish, costal streaks, the first near the base and the last at the apex; all are faintly dark margined internally; the last three or four are nearly perpendicular to the costal margin, crossing the wing and uniting near the dorsal margin, where they are narrow and indistinct. There is also a small black apical spot, behind which are three dark hinder marginal lines in the fringes; a second one is at the middle, and a third at the apex and the first at the base of the fringes. The one at the base of the fringes becomes furcate in the dorsal fringes. The wings expand about one-third of an inch. All the states of this insect are shown in Fig. 230.

THE APPLE TREE CASE-BEARER.

(*Coleophora malivorella* Ril.).

These interesting insects are found from time to time in large numbers on the twigs of apple trees. They make curious pistol-shaped cases, which on examination will reveal the little architect inside; it is a minute larva of a pale-yellow color, with a faint rosy tint, a black head, and a few short hairs on its body. The cases, which the caterpillars carry always with them, are very tough, almost horn-like, and form a very safe protecting shelter. When at rest the caterpillars hoist these cases in the air, as shown in the illustration, Fig. 231, *a*. Similar cases are quite common on the white-oak. As soon as the buds of the apple-trees commence to swell these cases are found sticking to their outside, while the active little caterpillar is busily engaged in destroying the tender leaves enclosed in them. Many fruit-buds are thus destroyed, and nothing but their hollow shells remain. Later in the season these active insects leave the twigs and fasten their cases to leaves, from which they eat the green pulp, so that nothing remains but a mere skeleton. Soon after changing late in June to pupæ the moths appear, which deposit eggs, from which in the same season a new brood of caterpillars hatches, which feed on the under side of the leaves until the frost drives them to the twigs, to which they fasten very securely their little cases.

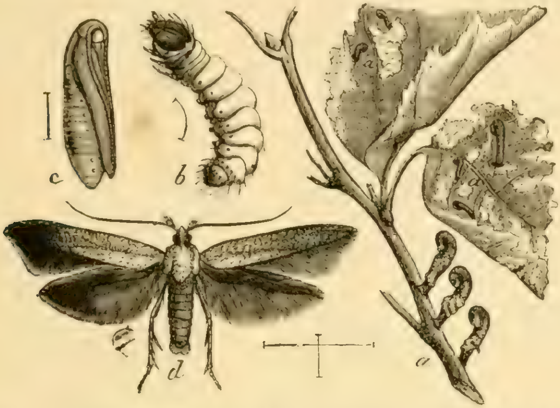


Fig. 231.—*Coleophora malivorella* Ril. From Div. of Entomology, Dep. of Agriculture.

The minute moth, measuring a little more than half an inch across the wings, has brown wings with white scales; the head and thorax is white, the abdomen whitish, and all are dotted with brown scales.

GRAPE-VINE LEAF MINERS.

(*Antispilla spec.*).

There are a number of mines found in the leaves of the wild and cultivated grape-vines, as well as in the closely related Virginia-creepers. The minute caterpillars which make these mines, form peculiar silken cases in which they pupate, and as these cases are of different shapes they are evidently made by different insects. A number of moths have been described which make these mines; they are: *Antispilla viticordifoliella* Clem., *A. ampeliopsiella* Cham., and *A. isabella*. These moths are very much smaller than their names, and do not occur in sufficient numbers to cause any serious injury. They are frequently parasitized, notwithstanding their apparently perfect protection by leaf and silky cocoon.

THE SPOTTED TENTIFORM MINE OF THE APPLE.

(*Lithocolletis cratægella* Clem.).

The caterpillar of this insect makes on the under side of an apple leaf a tentiform mine, which has the upper surface spotted and honey-combed. When we open such a mine early in September we discover in it a yellowish larva of a

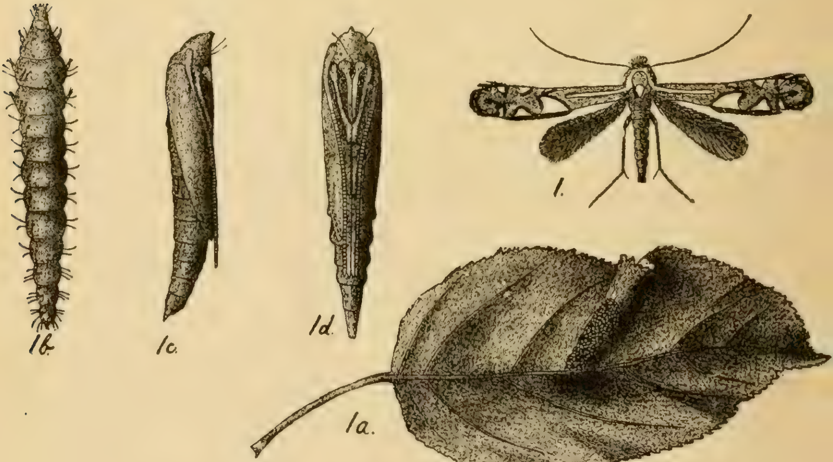


Fig. 232.—*Lithocolletis cratægella* Clem. After Comstock.

cylindrical form, with a very long head, which is wedge-shaped, quite pointed and bilobed. The peculiar shape of this larva is shown in the illustration, Fig. 232. It pupates in one end of the mine in a loose silken covering.

The moth has golden-brown fore-wings with white streaks and spots. The face and lower side of antennæ are silvery white. There is a black apical spot. It expands from three to five-sixteenths of an inch.

THE PEAR AND APPLE-TREE LEAF-MINER.

(*Lithocolletis geminatella* Pack.).

Among the numerous insects that mine the leaves of our apple this insect becomes sometimes quite numerous, and the blotched and disfigured foliage plainly indicates its presence. The worm is a very small being, of a pale reddish color, with a black head and cervical-shield. As a general rule it draws two leaves together, and unites them by means of strong silken fibres; at other times it folds up a single leaf. During August the larva changes to a very long and slender pupa within the mine, and soon afterwards the perfect insect appears, which deposits the eggs for another brood, which winters in the larval or pupal state inside the leaves. They can be materially reduced in numbers by gathering all the fallen leaves and by burning them. (Fig. 233).

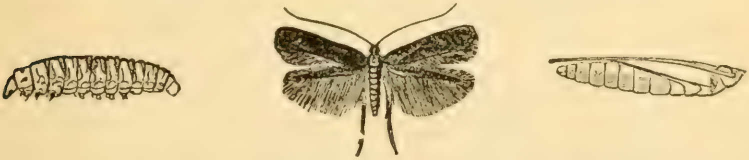


Fig. 233.—*Lithocolletis geminatella* Pack. After Saunders.

The moth expands about one-third of an inch across the wings. The fore-wings are dark-gray, with a round blackish spot on the middle of the inner edge of the wing; there is also an eye-like spot on the outer edge, with a black pupil.

Other species of Lithocolletis also mine in the foliage of the apple.

THE APPLE LYONETIA.

(*Lyonetia saccatella* Pack.).

This is a very minute and beautiful moth, measuring scarcely one-fifth of an inch across the expanded wings. It is not common, but some are found in early summer. Its wings are of a light slate-gray color on the basal half, while the outer half is bright orange, enclosing two white bands, one arising on the front edge, the other on the inner margin, both nearly meeting in the middle of the wing; these white bands are margined externally with black; there is also a conspicuous black spot near the fringe, from which arises a pencil of black hairs.

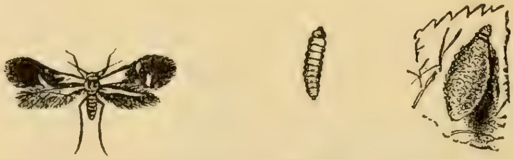


Fig. 234.—*Lyonetia saccatella* Pack. After Saunders.

According to Saunders the small flattened and green larva feeds on apple leaves; it constructs from the skin of the leaf an oval and flattened case which forms its house. This case is open at each end, and is drawn about by the insect as it moves from place to place. When the insect reaches its full size it attaches this case or bag to the bark of the tree on which it had been feeding, transforms to a pupa, in which condition it passes the winter, giving forth the moth in the following spring. The insect is shown in Fig. 234.

THE APPLE-LEAF BUCCULATRIX.

(*Bucculatrix pomifoliella* Clem.).

The larvæ of this minute moth live exposed on the foliage of the apple trees. They are very active and as soon as disturbed let themselves down from the leaf by means of a silken thread. They reach a length of about half an inch and have dark yellowish-green bodies, the anterior portion tinged with reddish; their heads are brown and a few short hairs are scattered over the surface of their bodies. As soon as full grown they spin an elongated whitish cocoon attached to the twig on the leaves of which they had been feeding. The cocoon is ribbed longitudinally; inside of it the caterpillar changes to a brown pupa. A second brood appears late in autumn, the insect hibernating in the pupal state. In the following spring the moths appear which deposit the eggs for the first brood of caterpillars abounding in June.

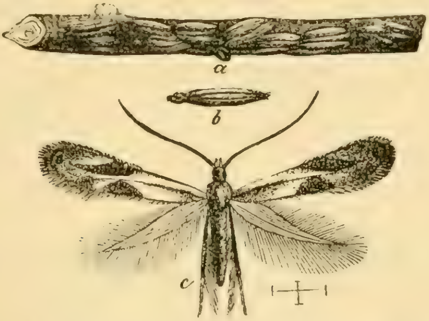


Fig. 235.—*Bucculatrix pomifoliella* Clem. After Riley.

The moth is a very delicate being, of a whitish color, tinged with pale-yellow and dusted with brown. On the middle of the inner margin of the fore-wings is a large oval patch of dark brown, forming when the wings are closed a conspicuous nearly round spot; there is also a wide streak of the same color opposite, extending to the front margin, and a dark brown spot near the tip.

As this insect appears sometimes in very large numbers, coating the twigs with glistening white cocoons, it can become injurious, but as the very conspicuous cocoons can be seen very plainly during late autumn, winter and early spring there is ample opportunity to destroy them. Any oily or alkaline liquid brushed over them will soak into the cocoons and destroy the hibernating insects. Sometimes the great majority of these insects are destroyed by a very minute hymenopterous parasite, as is shown by the small round holes at one end of the cocoons through which our tiny friends have escaped. The insect is shown in Fig. 235.

THE APPLE-LEAF MINER.

(*Tischeria malifoliella* Clem.).

This common insect lives as a larva within the leaf of the apple, in a mine made between the upper and lower skin, where it eats the soft tissues. The mine commences as a slender white line, broadening as the larva grows larger, and at last becoming an irregular brownish-patch, which extends sometimes to or over the starting point. The inhabitant of this mine is a pale-green caterpillar with a brown head and first segment. When full grown it draws the leaf into a fold, and in this enclosure, which is nicely carpeted with silk, it changes to a pupa. As this change takes place in autumn the snugly enclosed insects drop with the dead leaves, and remain in them until the following May, when they give forth the moths. This is a very minute being, measuring not much more than a quarter of an inch across the expanded wings. The fore-wings are of a shining dark brown, suffused with a tinge of purple, and slightly dusted with dull yellowish atoms; the hind wings are gray.

Besides the common apple this caterpillar mines in the

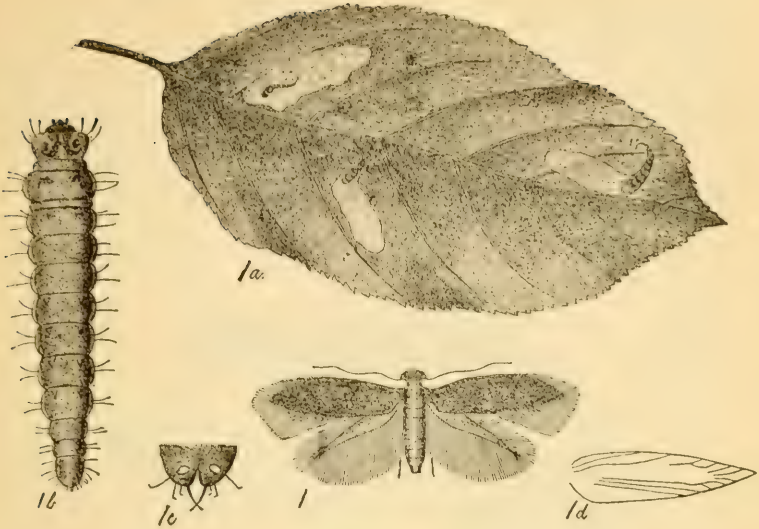


Fig. 236.—*Tischeria malifoliella* Clem. After Comstock.

leaves of the crab-apple, of the blackberry and the raspberry, but is not found in sufficient numbers to do any material injury. It is illustrated in Fig. 236.

THE RESPLENDENT SHIELD-BEARER.

(*Aspidisca splendoriferella* Clem.).

This interesting insect is sometimes found in Minnesota, but thus far only in very limited numbers. Its life-history is well known. The minute but very beautiful moth is found late in May; it has a golden head; the antennæ are brown, tinged with gold; the fore-wings from the base to the middle are of a leaden-gray with a metallic lustre, and from the middle to the tip golden; a broad silvery streak extends from the front edge to about the middle, margined with a dark color on both sides; there are also other streaks and spots of silvery or dark brown. The hind-wings are of a rich deep gray, margined with a long yellowish brown fringe. These beautiful creatures enjoy the sunshine, and are frequently found running about the surface of the apple leaves; during these active movements, which almost look like dancing, they have their wings closely folded to the body, as if afraid their fine dresses might become soiled. They deposit their eggs on the apple leaves, and the young larva as soon as hatched penetrates to the interior of the leaf, where it forms a mine, leaving both surfaces of the leaf intact, but forming after a time an irregular dark colored blotch upon the leaf. The peculiar looking larva, which is like all leaf-mining larva quite flat, is about one-eighth of an inch long, and of a yellowish-brown color, with a dark head. As the time

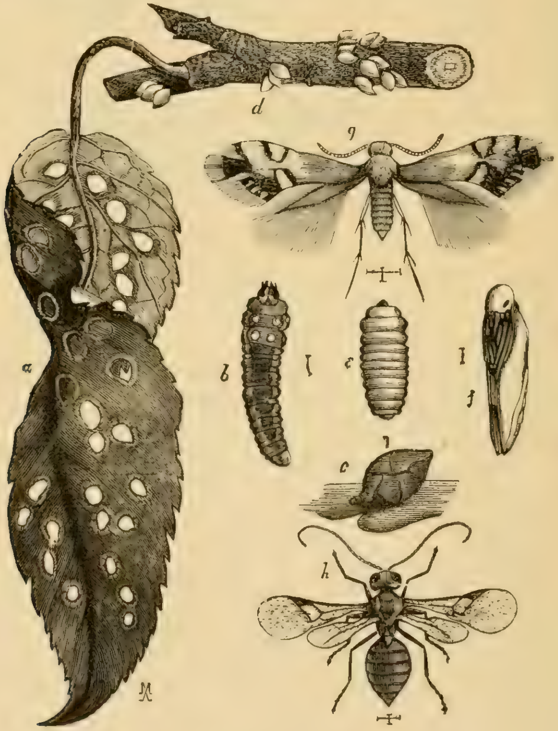


Fig. 237.—*Aspidisca splendoriferella* Clem. From Div. of Entomology, Dep. of Agriculture.

arrives in which it has to transform to a pupa, it constructs from parts of the leafy blotch a neat little case, and crawling with it to a twig it fastens the case securely to it. It now contracts inside this shelter and finally transforms to a pupa. The different states of this little beauty are shown in Fig. 237.

There are two annual broods, the latter hibernating in the little houses just mentioned.

Though so very small the insect can increase very rapidly in numbers and become injurious to our apple trees. If this happens the cocoons, which can readily be detected, should be removed or should be soaked with an alkaline wash or a mixture of sulphur and lime. This mixture, which is also good for various other insects, is made by mixing five pounds of fresh lime with one pound of sulphur and two gallons of water, and heating until the sulphur is dissolved.

THE BLACKBERRY LEAF-MINER.

(*Nepticula rubifoliella* Zell.).

This is a minute species the adult of which is described as follows: Head dark luteous. Palpi somewhat paler luteous. Antennæ luteous, basal joint silvery white. Forewings blackish-brown, with a rather narrow, curved, silvery band about the middle of the wing. The band is concave toward the base of the wing and shows a tendency to be interrupted in the middle. Fringes whitish. Hind-wings grayish, fringes the same.

Of the larva Dr. Clemens makes the following statement: "The larva mines the leaf of the blackberry in September. It makes a blotch mine on the upper surface of the leaf, beginning as a slender gallery, extending quite a distance, usually along a vein of a leaf before being enlarged into a blotch. The body of the larva tapers posteriorly, the terminal rings being attenuated; color pale-green with a bright dark-green vascular line; head greenish-brown and small. The larva was not taken from the mine for description. It leaves the mine very early in October to spin an oval, very dark reddish-brown cocoon and appears as an imago during the latter part of May or early in June. There is therefore, in all probability, a summer brood, which may be found in July and August, if the conjecture is correct."

THE CASE-BEARING BLACKBERRY LEAF-MINER.

(*Nepticula villosella* Clem.).

The larvæ of this species occur in the leaves of the blackberry during the latter part of June to the middle of July. The mine is very narrow, only about wide enough to accommodate the miner, tortuous, with a central frass line. The larva is pale brownish, and leaves the mine during the latter part of July. It differs from the above insect both in the shape of the mine and in the color of the larva.

As is usual when a leaf-mining larva has attained a certain age it cuts out the two skins of the mined place and constructs of it a portable case, which it never abandons subsequently, except to construct a new one when its increase in growth demands such a change. In feeding the larva attaches its case to a leaf, and bores into it between its skins, eating out a transparent patch, extending its body from the case for this purpose, but quickly retreats into it again if alarmed.

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Parasitic Insects destroying caterpillars and pupæ. From Gartenlaube.

PLATE I.

FIG. 4.

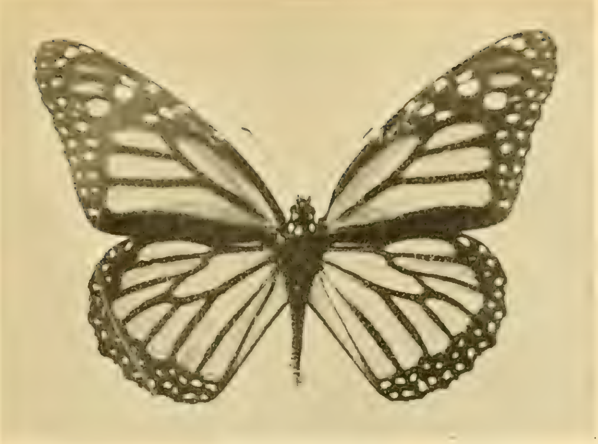


FIG. 5.

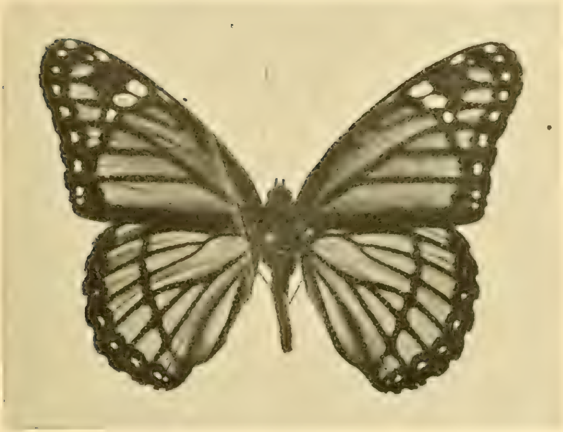


FIG. 2.

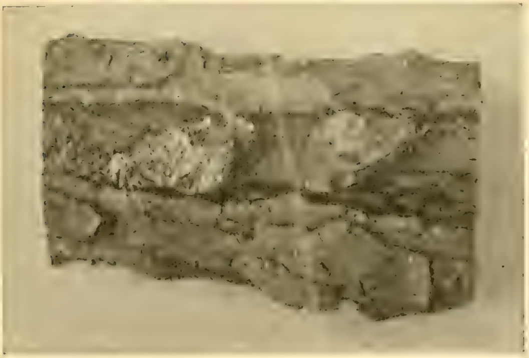


Fig. 4.—*Danais archippus* Fab.
Fig. 5.—*Limenitis disippus* Gdt.
Fig. 2.—*Marmoptery gibbicostatat* Walk., resembling bark.

PLATE II.

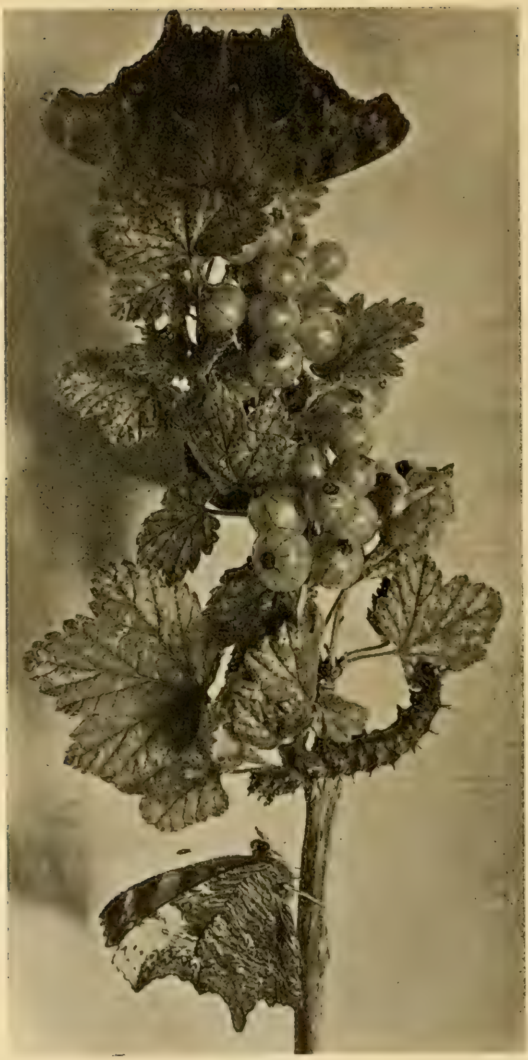


FIG. 17.

Fig. 17.—*Grapta comma* Harr., showing two butterflies, caterpillar and empty chrysalis.

PLATE III.

FIG. 21.

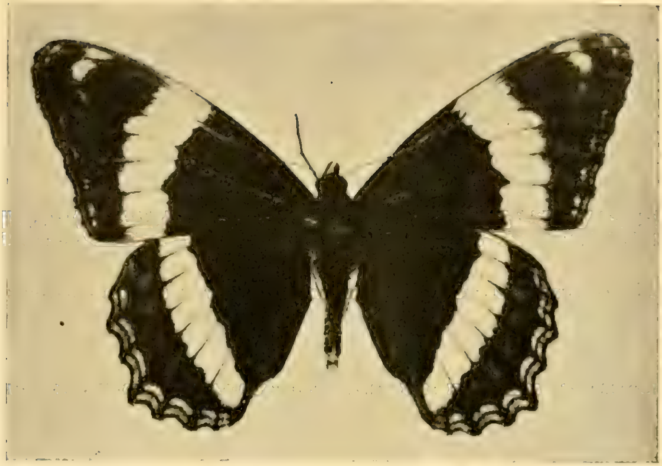


FIG. 22.

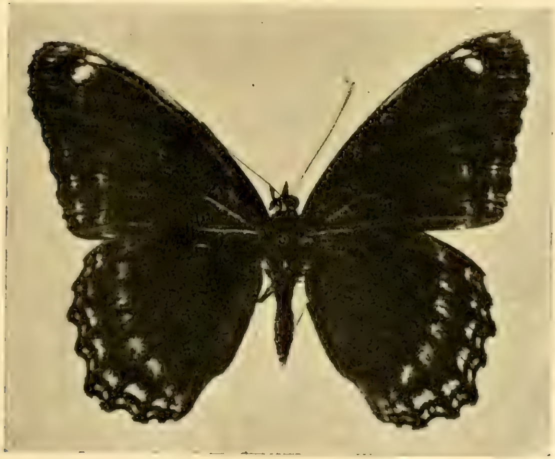
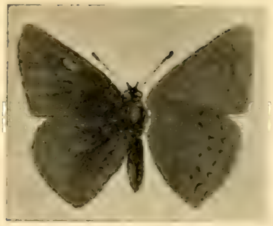


FIG. 23.



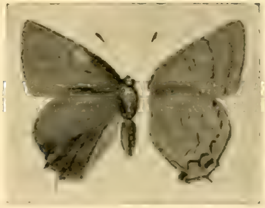


FIG. 24.

Fig. 21.—Limenitis arthemis Dru.
Fig. 22.—Limenitis ursula Fab.

Fig. 23.—Thecla titus Fab.
Fig. 24.—Thecla calanus Hub.

PLATE IV.

FIG. 27.

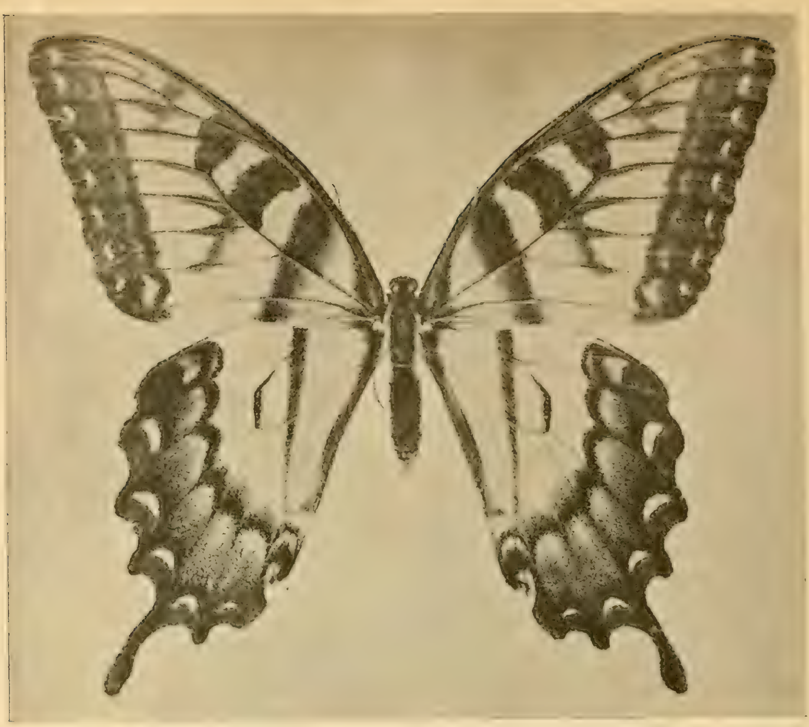


FIG. 29.

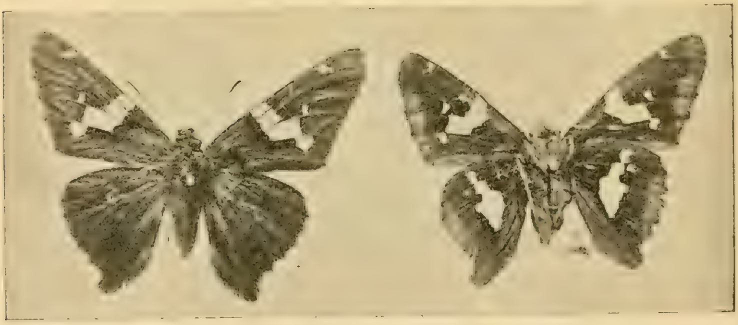
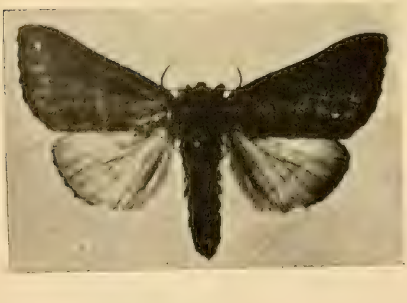


FIG. 108



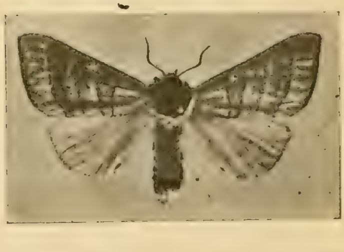


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Fig. 27.—*Papilio turnus* Linn.
Fig. 29.—*Eudamus tityus* Fab., both sides.

Fig. 107.—Datana integerrima G. & R
Fig. 108.—Datana contracta Walk.

FIG. 30.

FIG. 32.

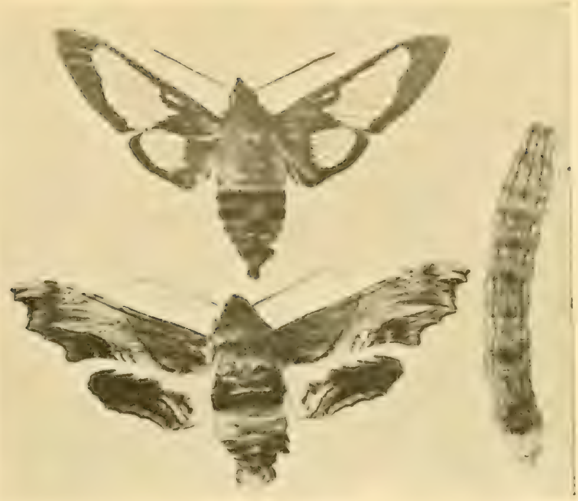
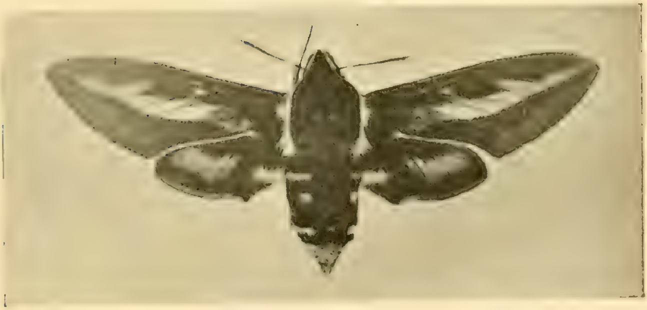


FIG. 37.



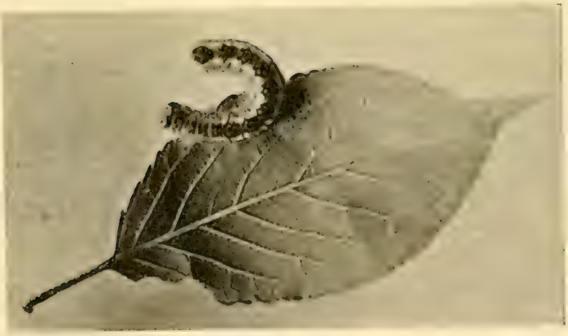


Fig. 30.—*Hemaris thysbe* Fab.
Fig. 32.—*Thyreus Abbotii* Swains. and larva.
Fig. 37.—*Deilephila galii var chamænerii* Harr.
Acronycta caterpillar on leaf of plum.

PLATE VI.

FIG. 43.

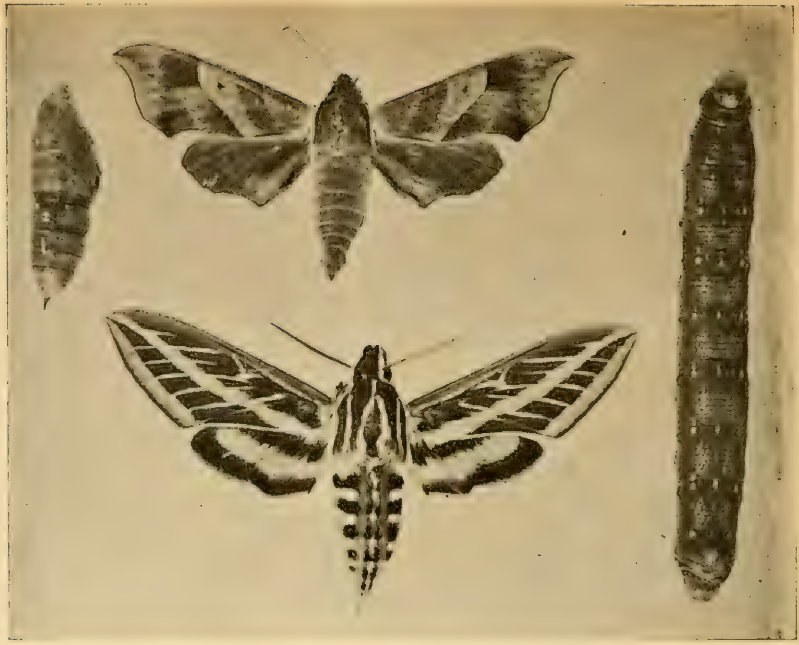


FIG. 36.

FIG. 48.

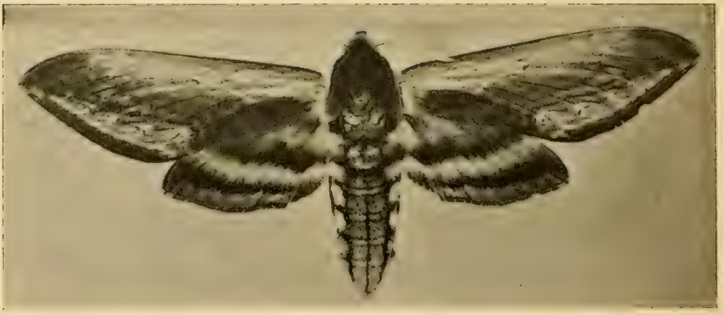


FIG. 51.

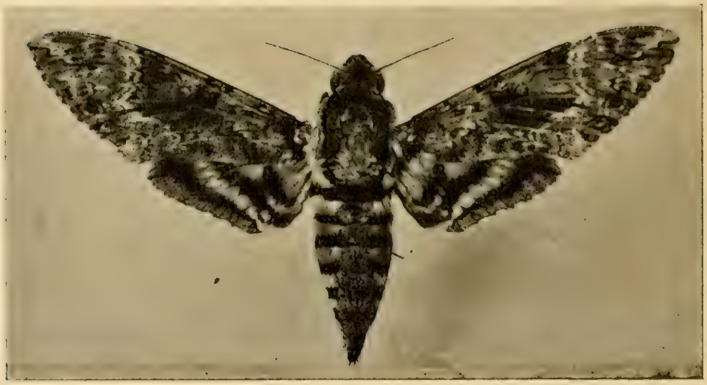


Fig. 43.—*Ampelophaga myron* Cram. and pupa.
Fig. 36.—*Deilephila lineata* Fab. and larva.
Fig. 48.—*Sphinx drupiferarum* S. & A.
Fig. 51.—*Sphinx gordius* Cram.

PLATE VII.

FIG. 39.

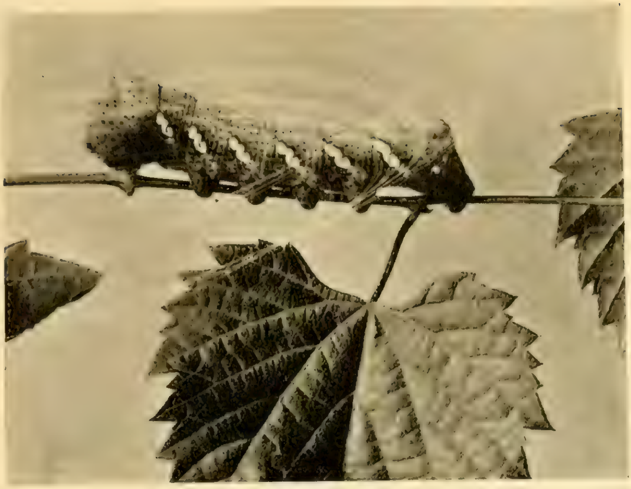


FIG. 40.

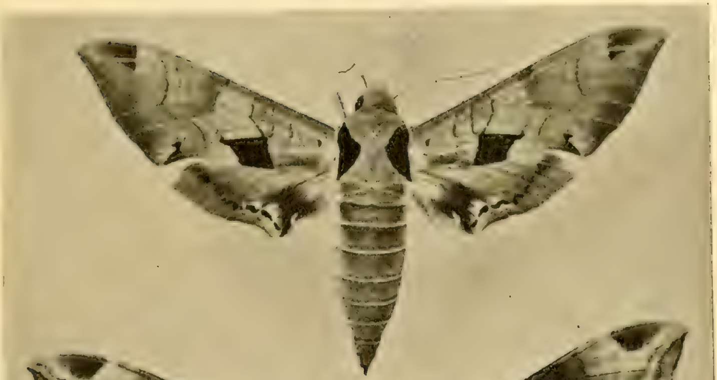


FIG. 42.

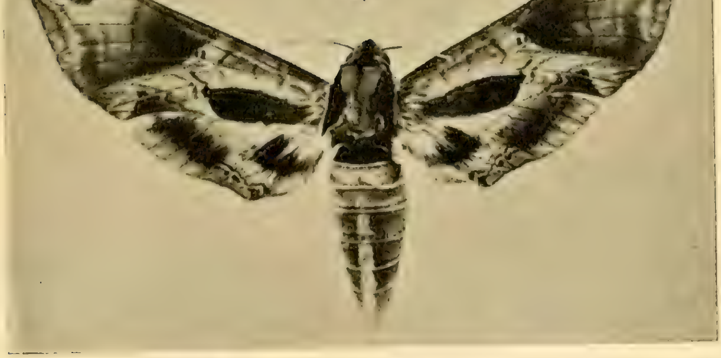


Fig. 39.—*Philampelus achemon* Dru., larva.
Fig. 40.—*Philampelus achemon* Dru.
Fig. 42.—*Philampelus pandorus* Hbn.

FIG. 56.

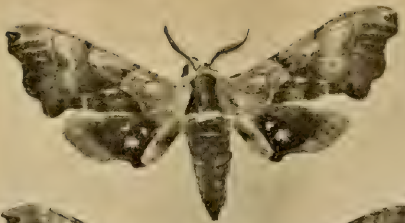


FIG. 53.

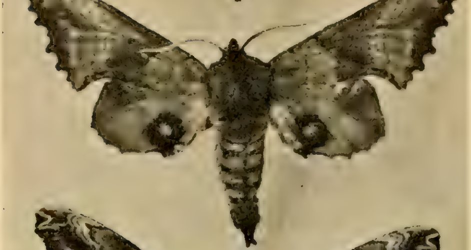


FIG. 54.

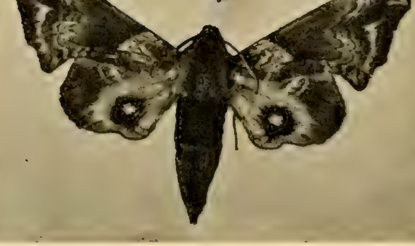


FIG. 57.

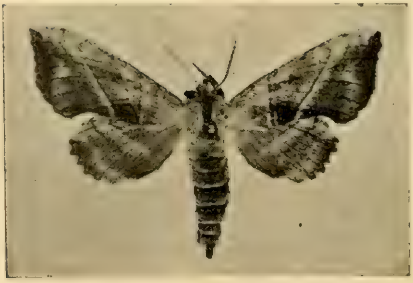
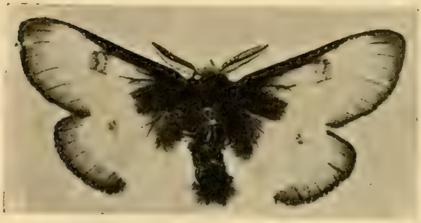


FIG. 132.



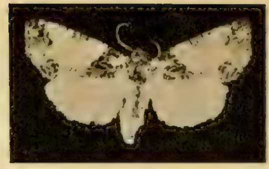


FIG. 164.

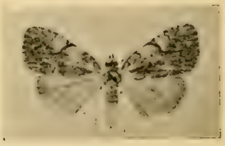


FIG. 169.

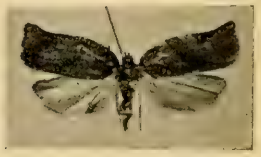


FIG. 211.

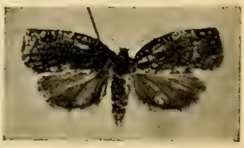


FIG. 212.

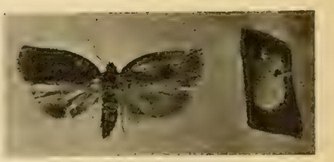


FIG. 21.

Fig. 53.—*Paonias excæcatus* S. & A.
Fig. 54.—*Paonias myops* S. & A.
Fig. 56.—*Smerinthus geminatus* Say.
Fig. 57.—*Cressonia juglandis* S. & A.
Fig. 132.—*Hemileuca maia* Drury.

Fig. 164.—*Chamyris cerintha* Tr.
Fig. 169.—*Nolaphana malana* Fitch.
Fig. 211.—*Cacœcia rosaceana* Harr.
Fig. 212.—*Cacœcia cerasivorana* Fitch.
Fig 214.—*Cacœcia argyrospila* Walk.

PLATE IX.

FIG. 60.

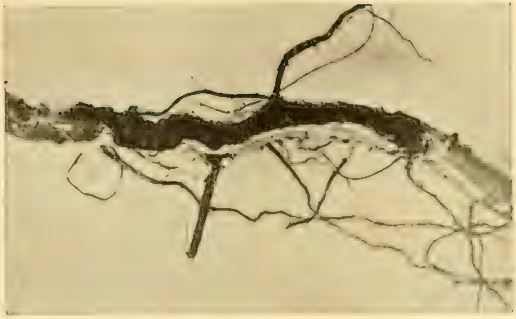


FIG. 62.

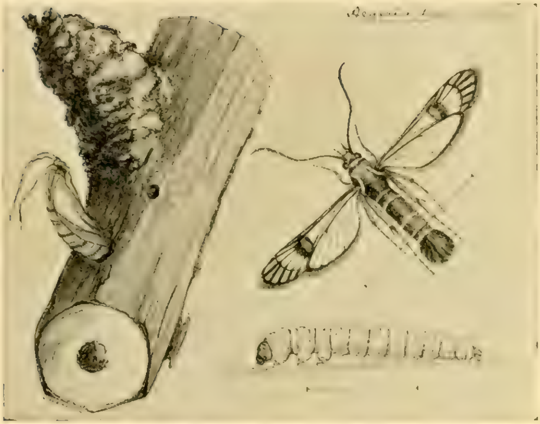


FIG. 72, *c*.

FIG. 72, *b*.

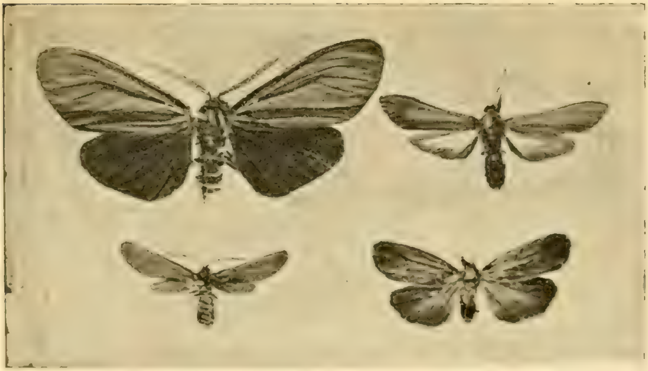


FIG. 72, *a*.

FIG. 72, *d*

Fig. 60.—Roots of plum tree infested with borers.
Fig. 62.—*Sesia tipuliformis* Linn.
Fig. 72, *a*, *Harrisima americana* Harr.; *b*, *Scepsis fulvicollis* Hbn.; *c*, *Ctenucha virginica* Charp.; *d*, *Hypoprepia fucosa* Hbn.

FIG. 65.

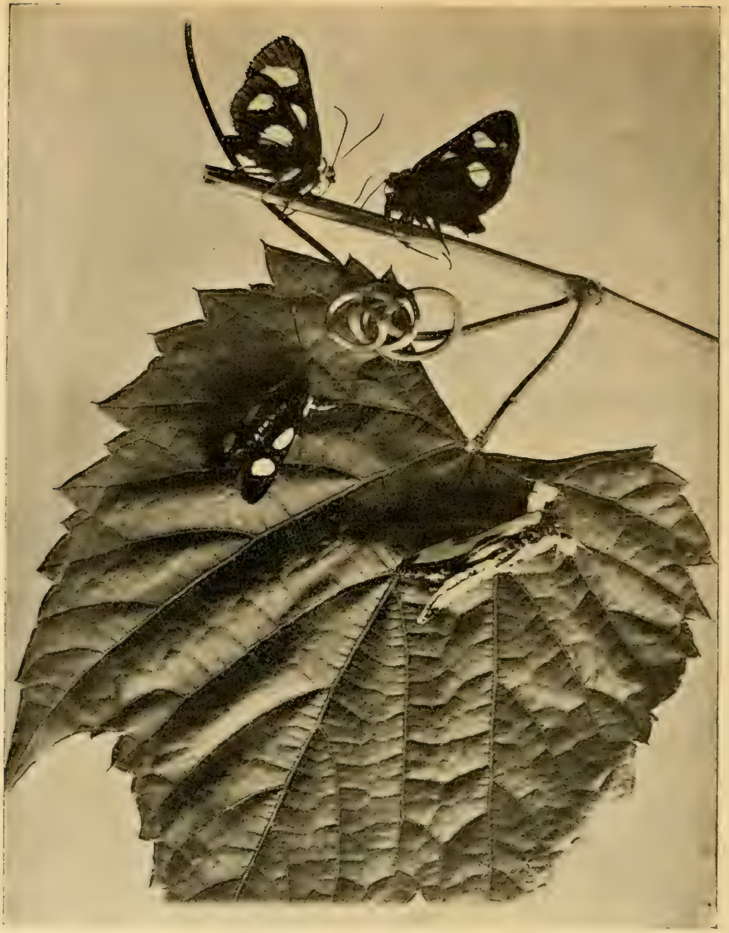


FIG. 70, *d*.

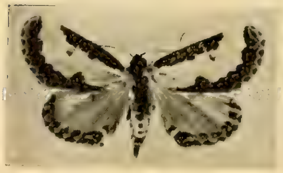


FIG. 70, *a*.

FIG. 70, *c*.

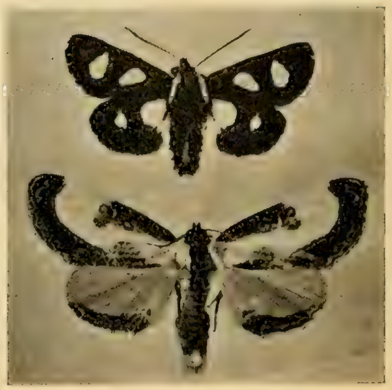


FIG. 70, *b*.

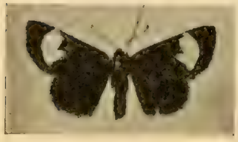


Fig. 65.—*Alypia 8-maculata* Hbn., three moths; and *Endryas grata* Fab., one moth.
Fig. 70, *a*, *Alypia 8-maculata* Hbn.; *b*, *Psychomorpha epimenis* Dru.; *c*, *Eudryas grata* Fab.; *d*, *Eudryas unio* Fab.

PLATE XI.

FIG. 64.

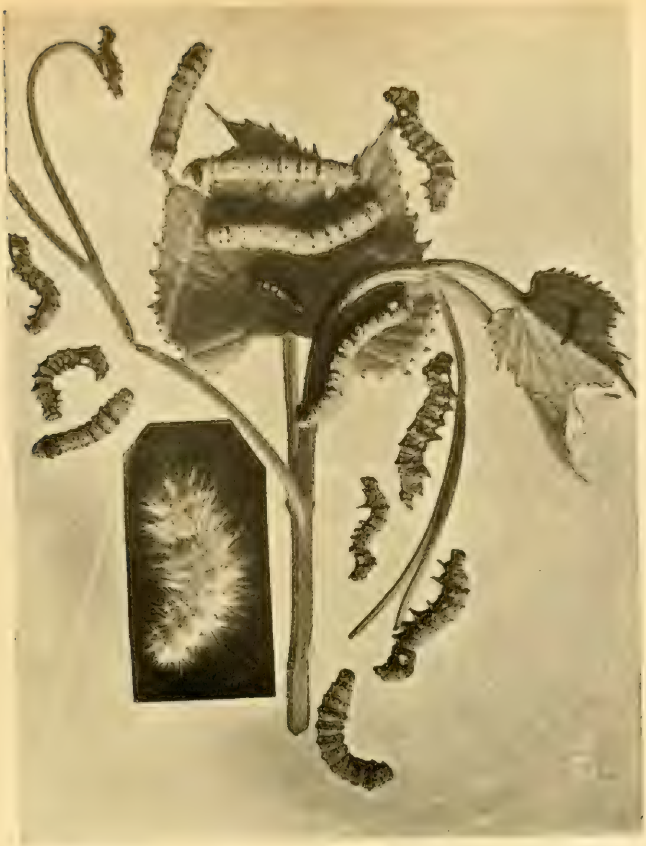


FIG. 76.

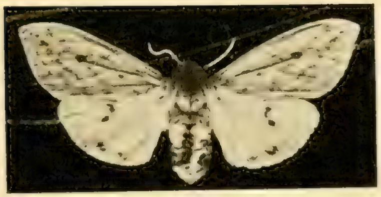


FIG. 77.

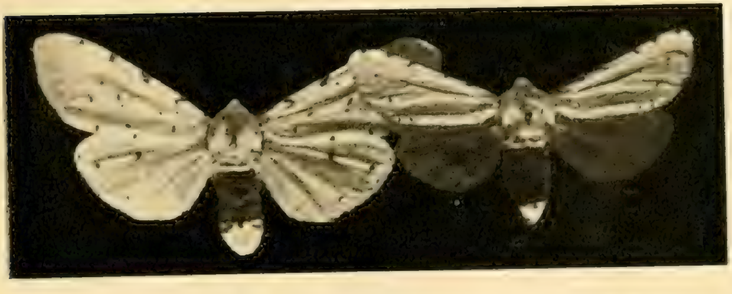


Fig. 64.—*Alypia octomaculata* Hbn., caterpillars, and one parasitized larva of *Spilosoma virginica* Fab.
Fig. 76.—*Pyrrharctia isabella* S. & A.
Fig. 77.—*Leucarctia acræa* Dru., male and female.

PLATE XII.

FIG. 68.

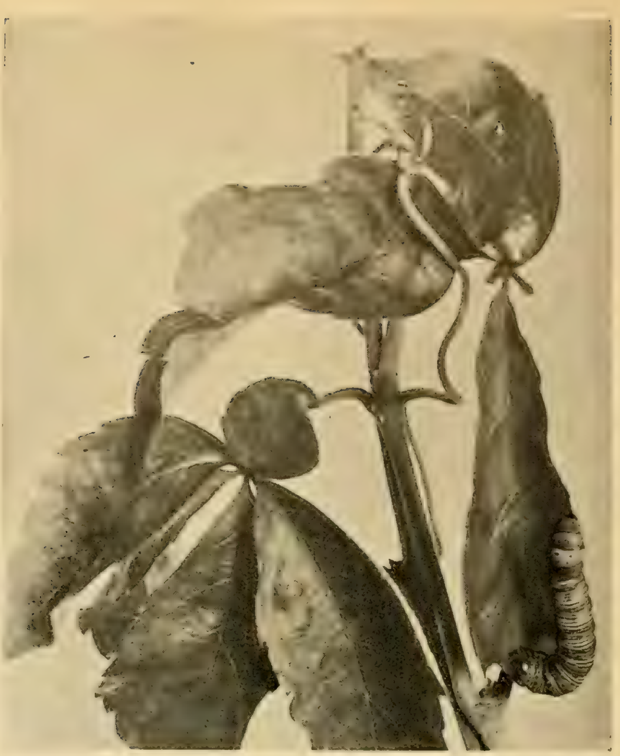
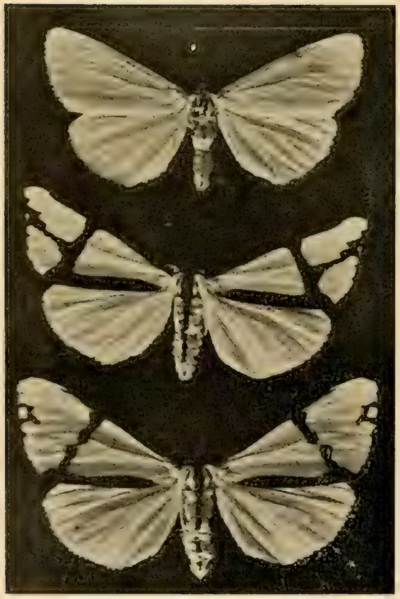


FIG. 74, *a*.

FIG. 74, *b*.

FIG. 74, *c*.



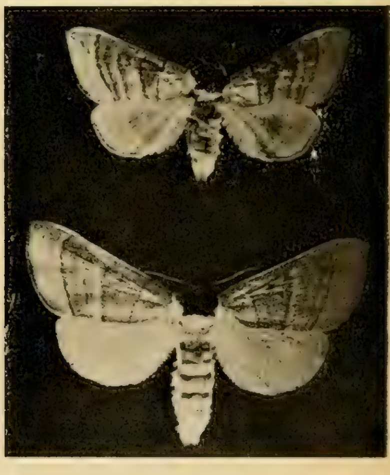


FIG. 105.

Fig. 68.—*Eudryas grata* Fab , caterpillar.
Fig. 74.—*a*. Callimorpha fulvicosta; *b* and *c*, Contigua Walk.
Fig. 105.—Datana ministra, male and female.

FIG. 123

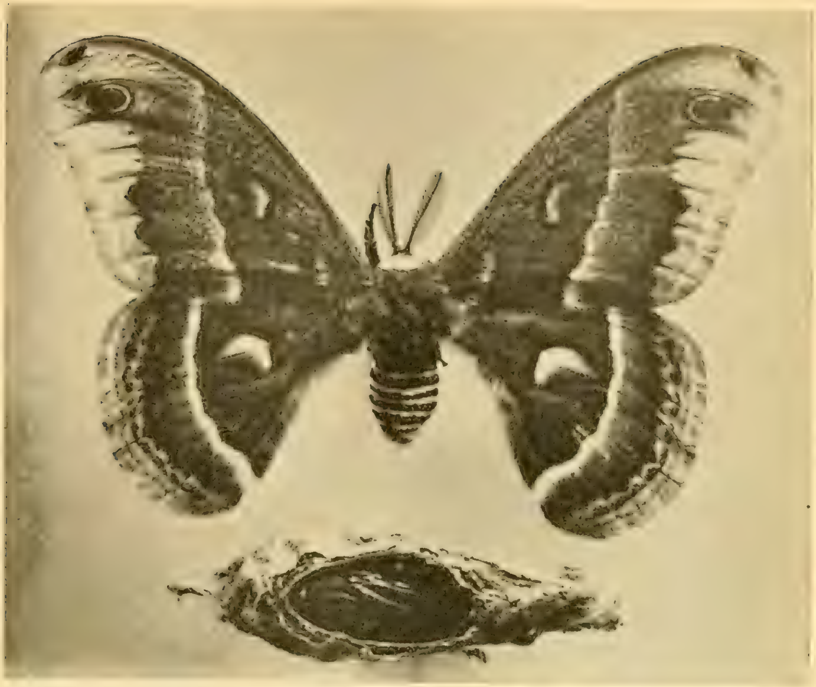


FIG. 126.

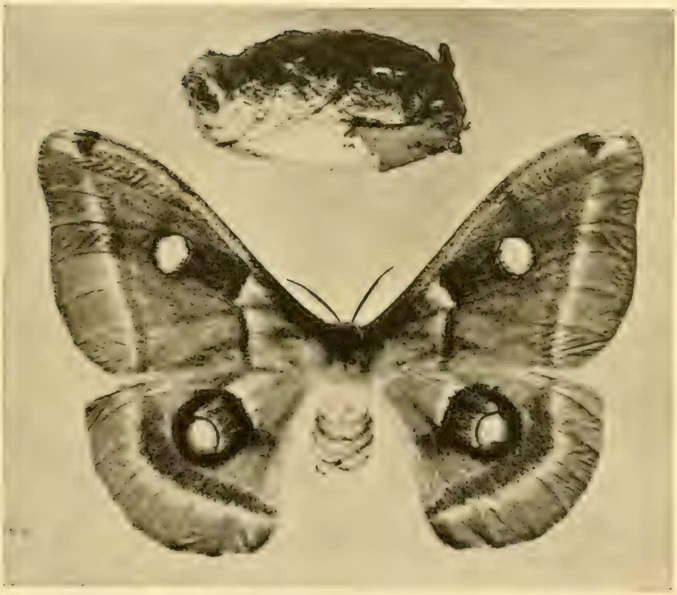


Fig. 123.—Attacus cecropia Linn., reduced in size.
Fig. 126.—Telea polyphemus Linn., reduced in size.

FIG. 124

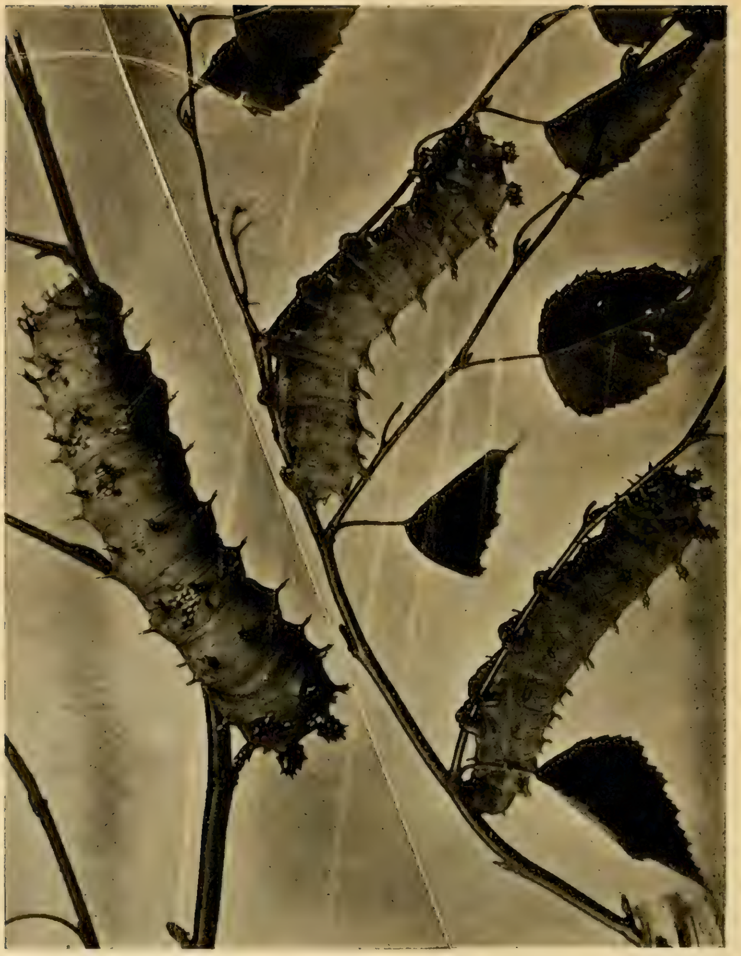
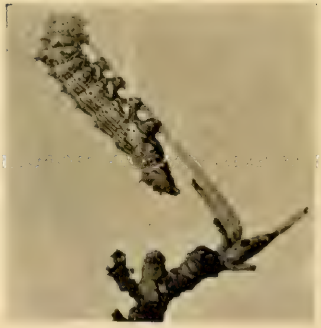


FIG. 110.



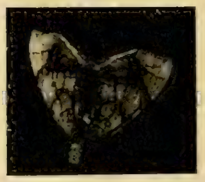


FIG. 199.

Fig. 124.—Parasitized caterpillars of Attacus cecropia Linn.
Fig. 110.—Œdemasia concinna, S. & A., caterpillar.
Fig. 199.—Petrophora diversilineata Hub., moth at rest.

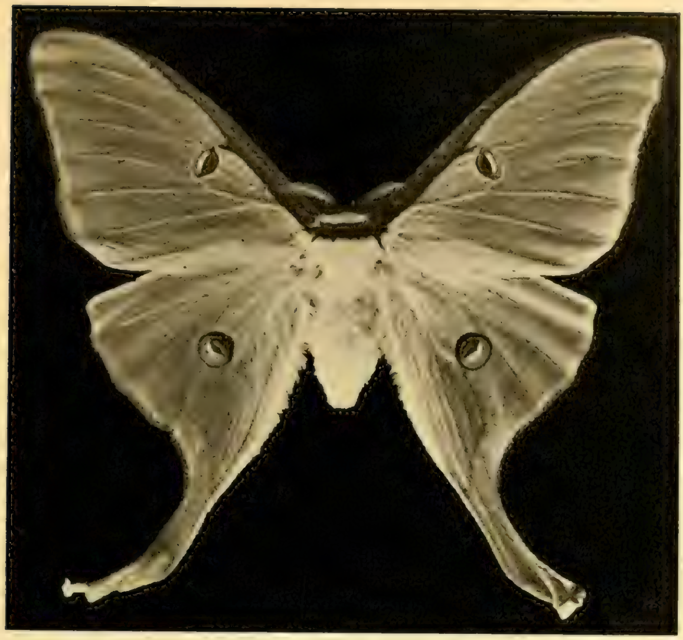


FIG. 128.

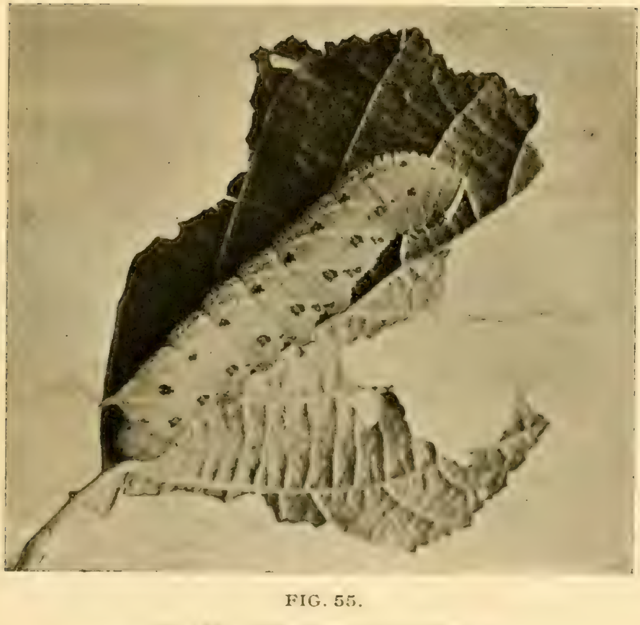
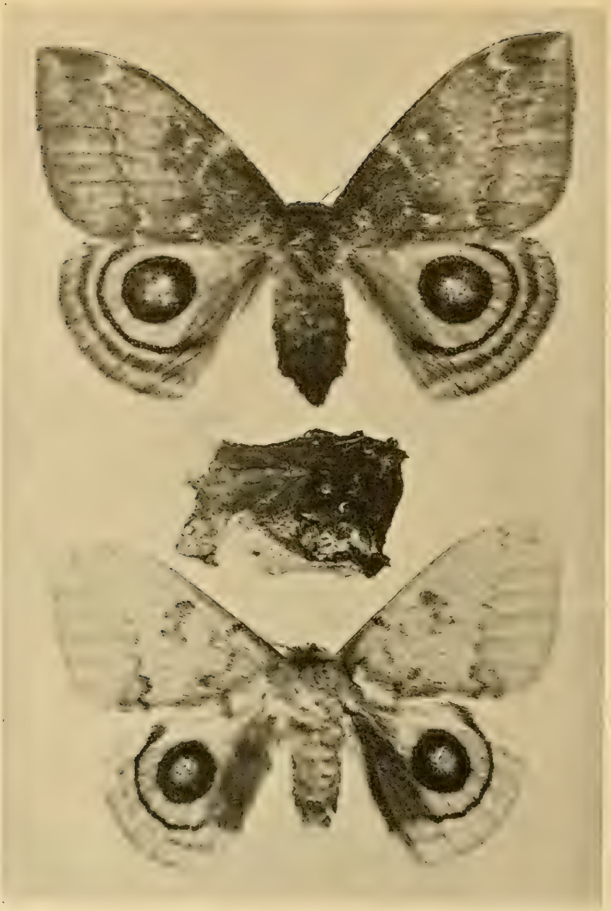


FIG. 55.

Fig. 128.—Actias luna Linn., reduced.
Fig. 55.—Smerinthus geminatus Say., caterpillar.

PLATE XVI.

FIG. 129.



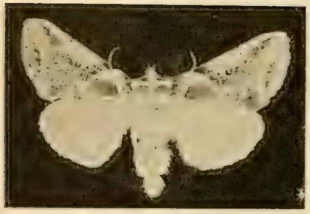


FIG. 151.

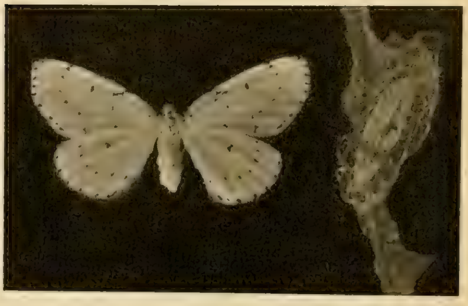


FIG. 187

Fig. 129.—Hyperchiria Io Linn., male and female.
Fig. 151.—*Thyatira scripta* Gosse.
Fig. 187.—*Caterva catenaria* Cram., and pupa in cocoon.

FIG. 137.

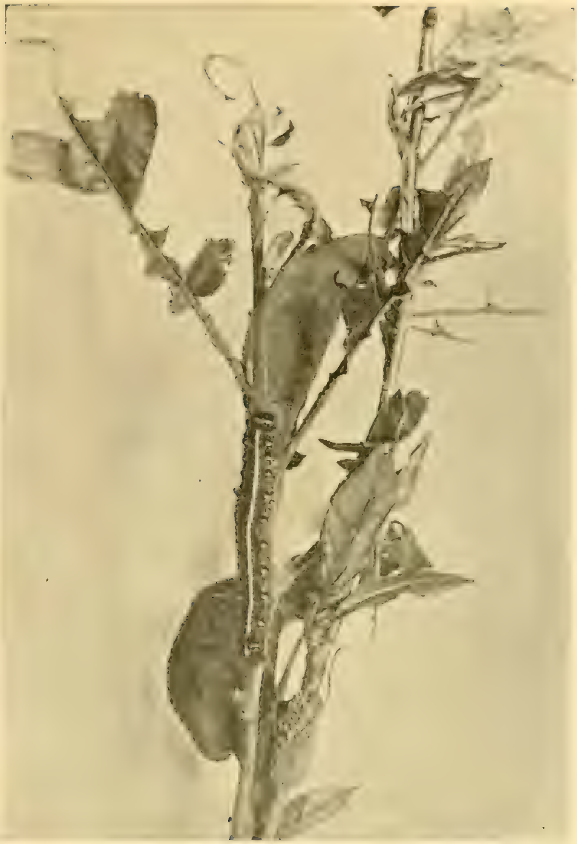


FIG. 140

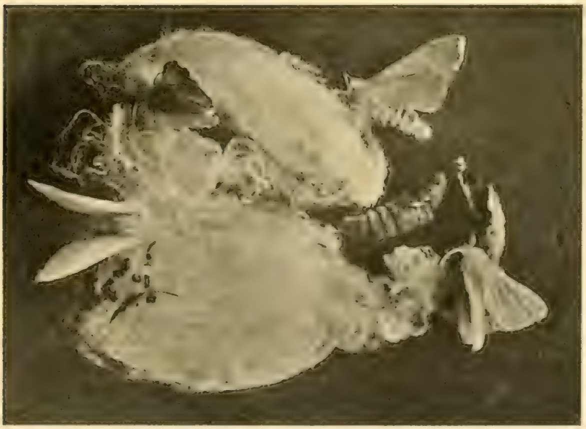


Fig. 137.—Caterpillar of Clisiocampa americana Harr.
Fig. 140.—Moths, pupa and cocoons of Clisiocampa distria Hub.

FIG. 138.

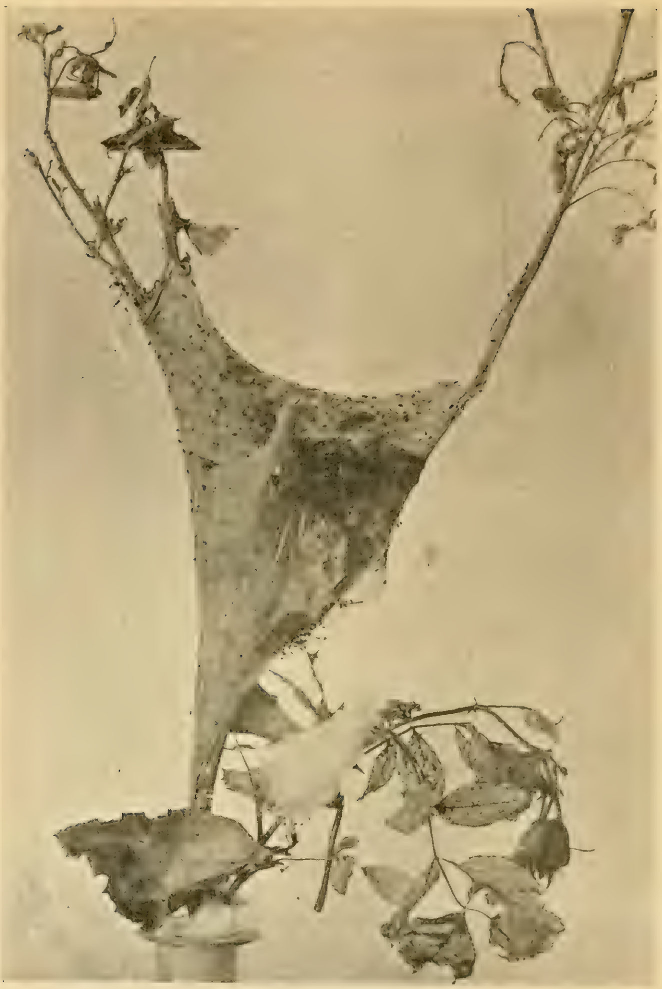


FIG. 181.

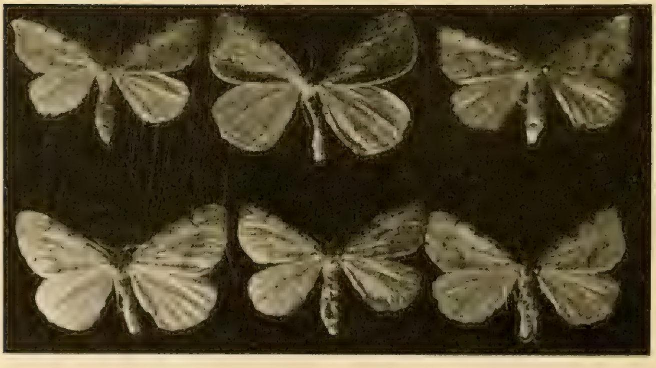


Fig. 138.—*Clisiocampa americana* Harr., tent.
Fig. 181.—Six forms of *Diastictis flavicaria* Pack.

PLATE XIX.

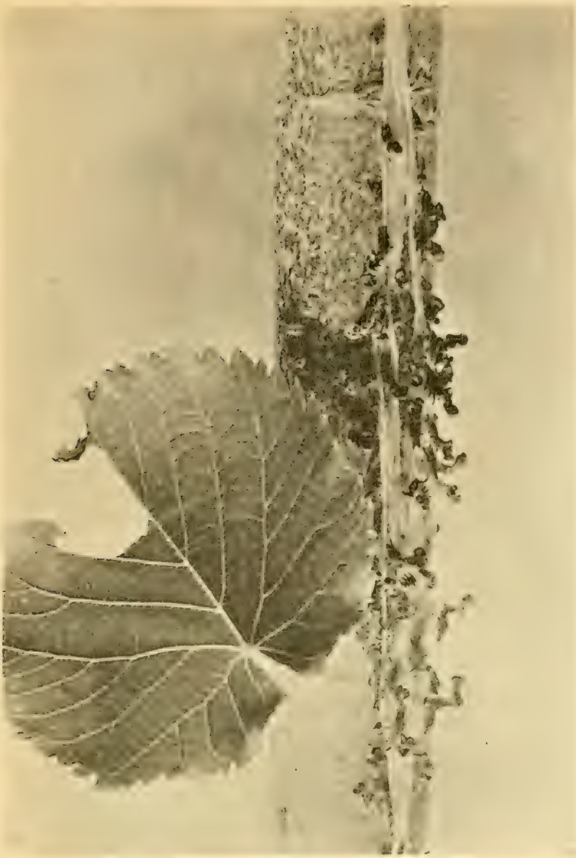


FIG. 142.

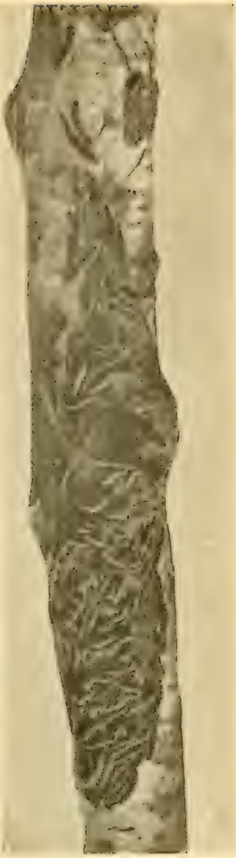


FIG. 141.

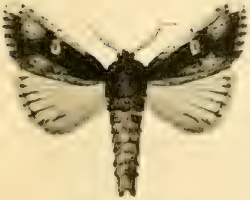


FIG. 114.

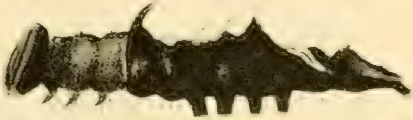


FIG. 115.

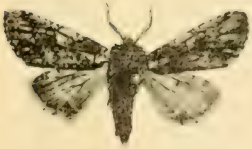


FIG. 113.

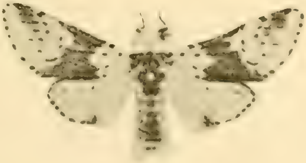


FIG. 121.

Fig. 141.—Clisiocampa distria Hub., larvæ crowding together; greatly reduced.
Fig. 142.—Clisiocampa distria Hub., empty skins of young caterpillars; natural size.
Fig. 114.—*Schizura ipomeæ* Doubl. Fig. 115.—*Schizura ipomeæ* Doubl., larva.
Fig. 113.—*Schizura unicornis* S. & A. Fig. 121.—*Cerura borealis* Bdv.

FIG. 143.

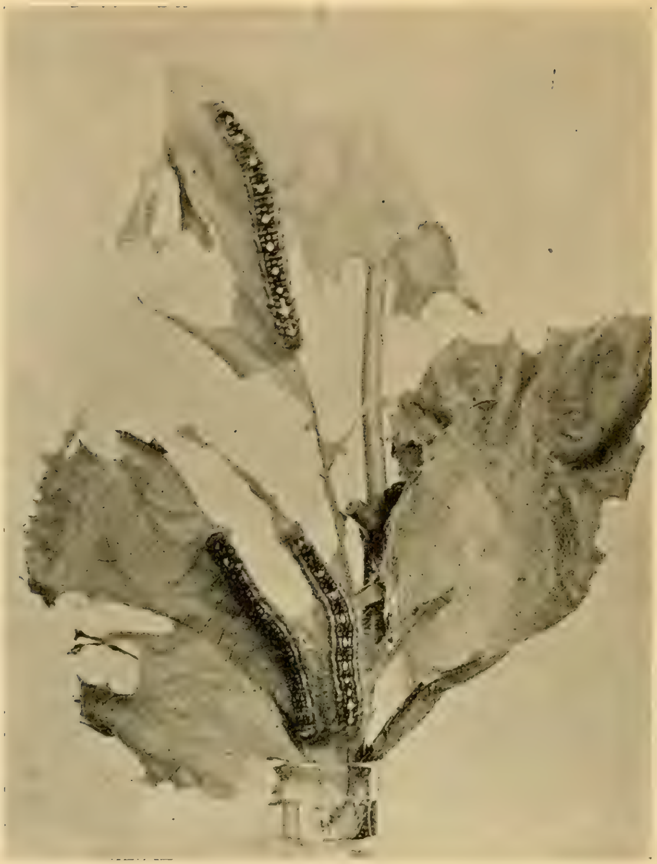


FIG. 95.

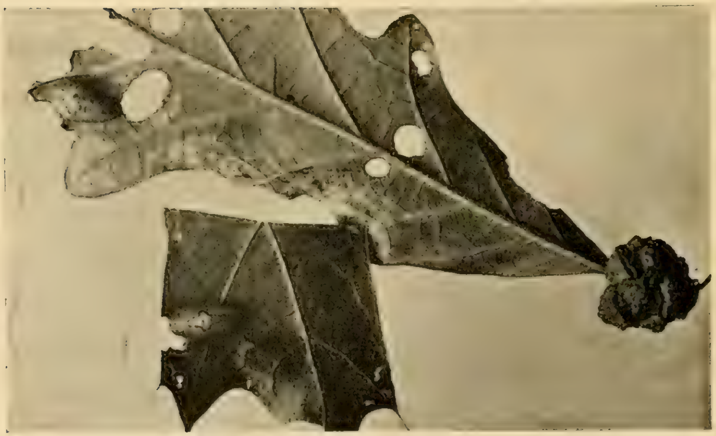


Fig. 143.—Clisiocampa distria Hub., caterpillars.
Fig. 95.—Slug caterpillars on oak leaf.

PLATE XXI.

FIG. 84.

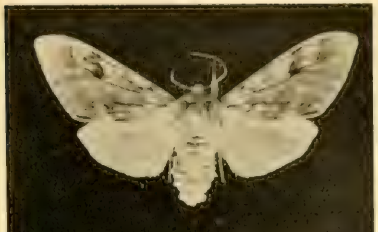


FIG. 87.

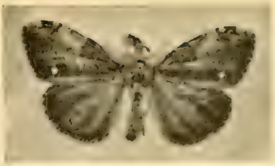


FIG. 86.

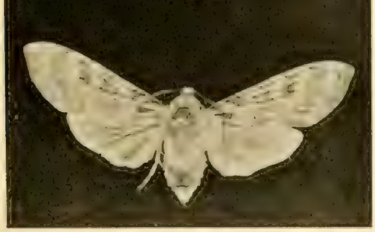


FIG. 88.

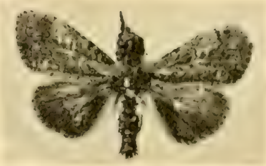


FIG. 85.

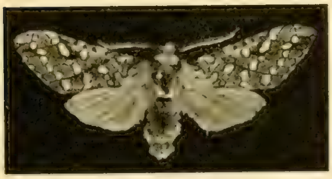


FIG. 90.

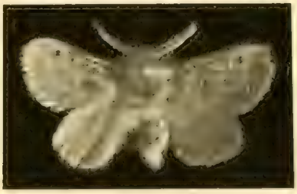


FIG. 83.

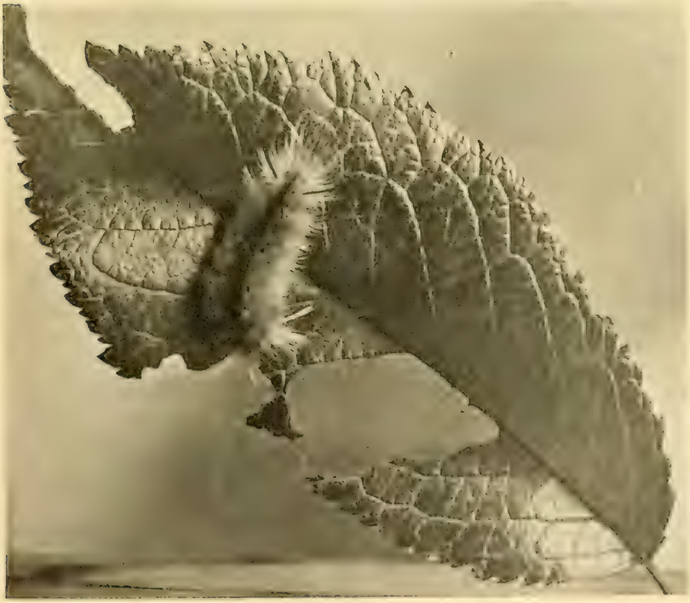


Fig. 83.—Halesidota tesselata S. & A., caterpillar

Fig. 84.—Halesidota caryæ Harr.

Fig. 85.—Halesidota maculata Harr.

Fig. 86.—Halesidota tesselata S. & A.

Fig. 87.—Orgyia leucostigma S. & A.

Fig. 88.—Parorgyia parallela G. & R.

Fig. 90.—Lagoa crispata Pack

FIG. 79.

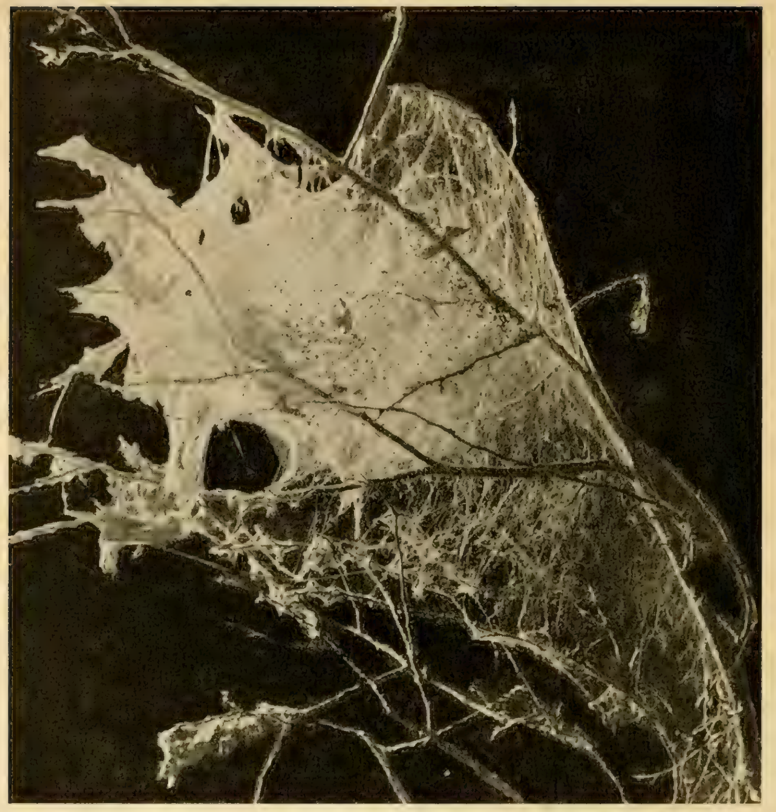
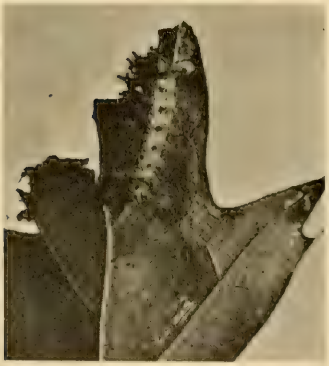


FIG. 92.



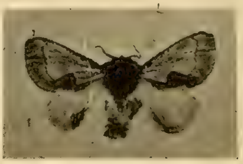


FIG. 94.

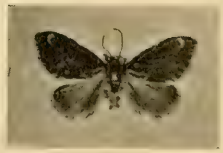


FIG. 96.

Fig. 79.—Hyphantria cunea Drury, tent.
Fig. 92.—Parasa chloris H. Sch., caterpillar.
Fig. 94.—Euclea pænulata Clem.
Fig. 96.—Adoneta spinuloides H. S.

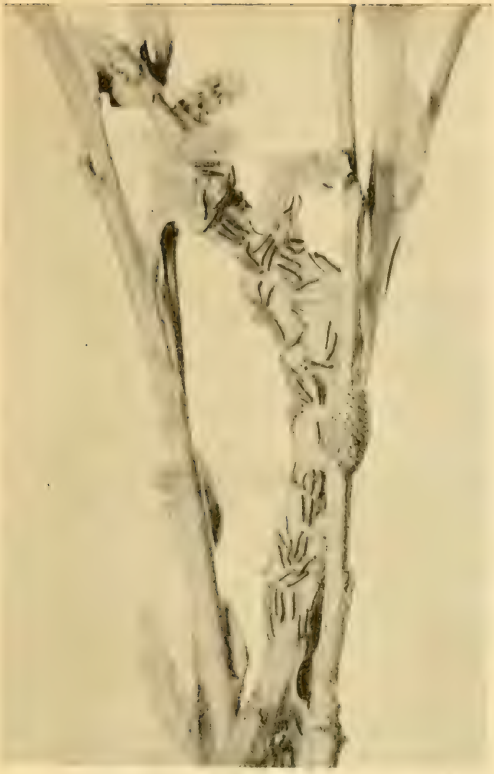


FIG 144.

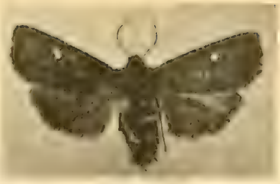


FIG. 170½.

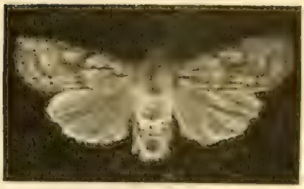


FIG. 173.

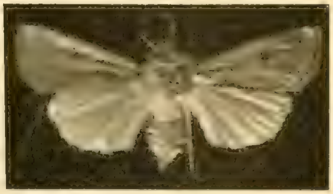
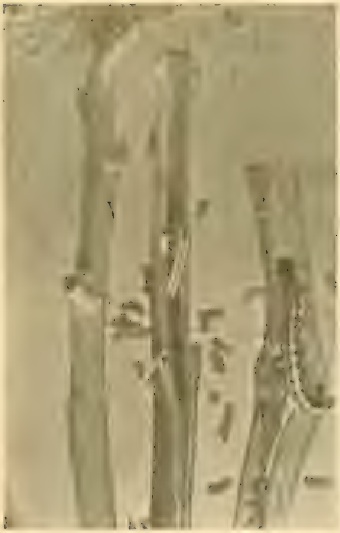


FIG. 160.

FIG. 166.



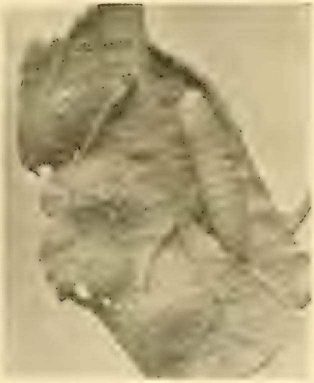


FIG. 170.

Fig. 144.—Tent caterpillars just hatched; also egg mass.
Fig. 166.—Larvæ of Gortyna nitela Gu., in stems of currant and grape vine.
Fig. 170½.—*Scopelosoma sidus* Gu.
Fig. 173.—*Xylina Bethunei* G. & R.
Fig. 160.—*Carneades scandens* Ril.
Fig. 170.—Caterpillar of *Nolaphana malana* Fitch.

PLATE XXIV.

FIG. 177.

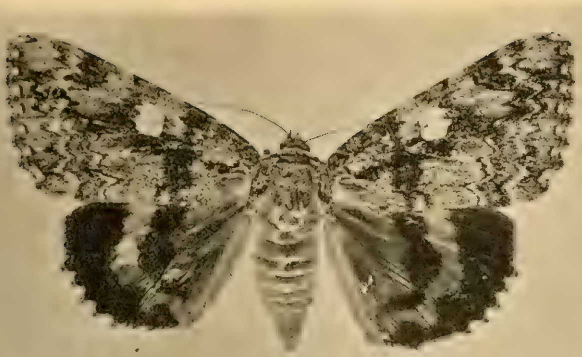


FIG. 175.

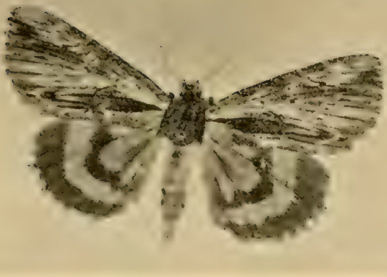


FIG 176.

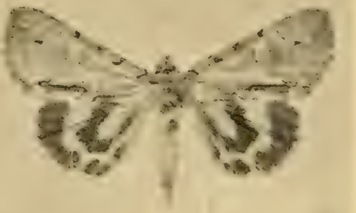


FIG. 147.

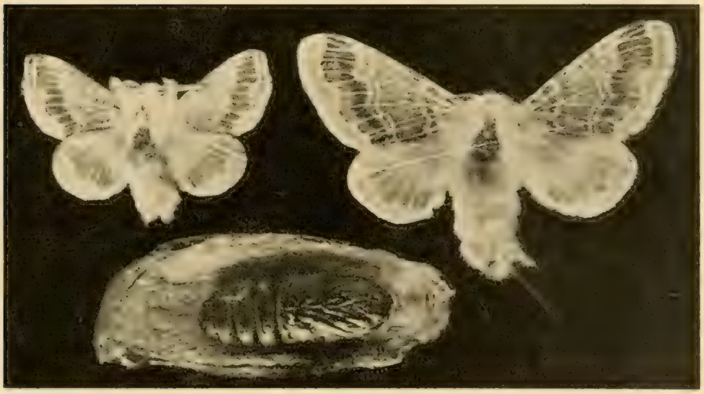


FIG. 149.

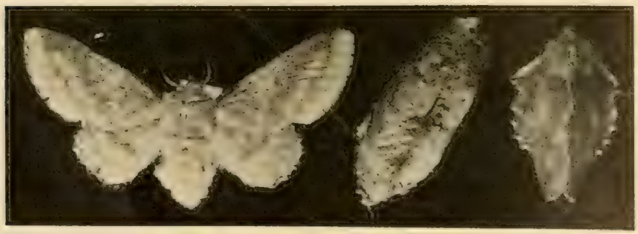


Fig. 147.—Tolype velleda Stoll., and open cocoon.
Fig. 149.—Gastropacha americana Harr.
Fig. 175.—Catocala ultronia Hub.
Fig. 176.—Catocala grynea Cram.
Fig. 177.—Catocala poleogama Gu.

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